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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS.

Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 24.

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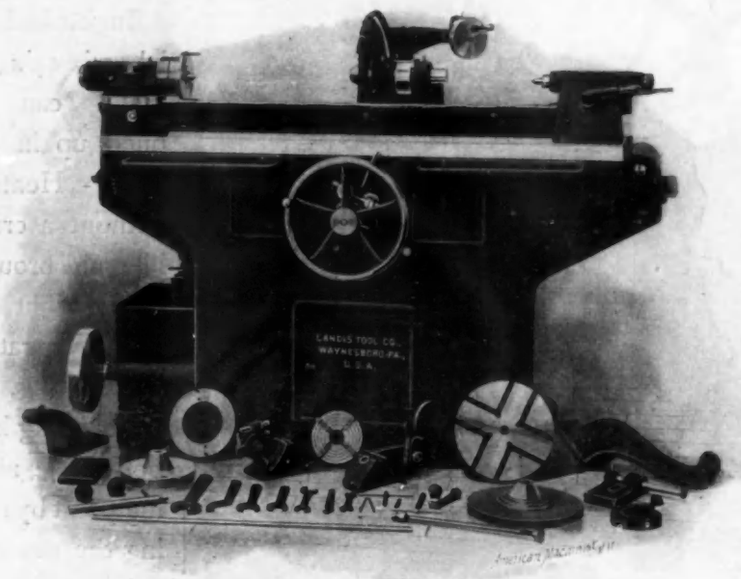
The Key to Greater Profits

in the machine shop is the Landis Grinder. There is no possible doubt about this; it has been demonstrated too often to be successfully controverted.



No. 3 UNIVERSAL GRINDING MACHINE—Front.

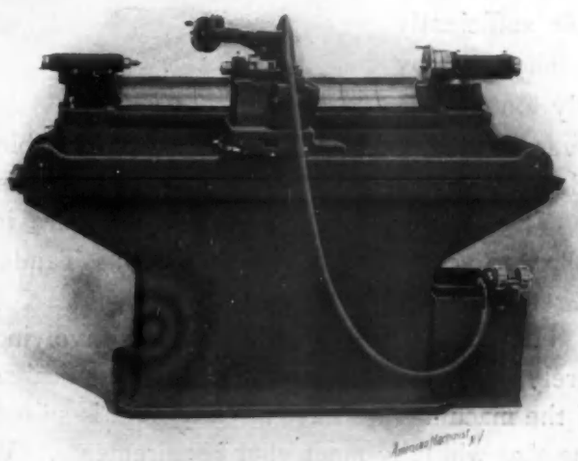
It makes no difference how many lathes you have, nor how good they are, you need a Landis Grinder to do the work that no known lathe can do in the right way—the accurate, money-making way.

The best Lathe ever built cannot do accurate work, even on soft material; on hard material it fails altogether.

With a Landis Grinder you can not only do work that no lathe is equal to, but you can make more money on it than the competitor who attempts to do it on a lathe, charging the same price, or you can make as much and do it for less.

There should be a Landis Grinder in your shop. It should be there just as soon as you can get it, because it will put you entirely out of the reach of competition on the class of work it does.

Write for our treatise on grinding — write right now. It tells all about Landis Grinders, and it can't hurt you a bit to read it, but will help you a great deal if you'll let it.



No. 3 UNIVERSAL GRINDING MACHINE—Back.

LANDIS TOOL CO.,

Waynesboro, Pa., U.S.A.

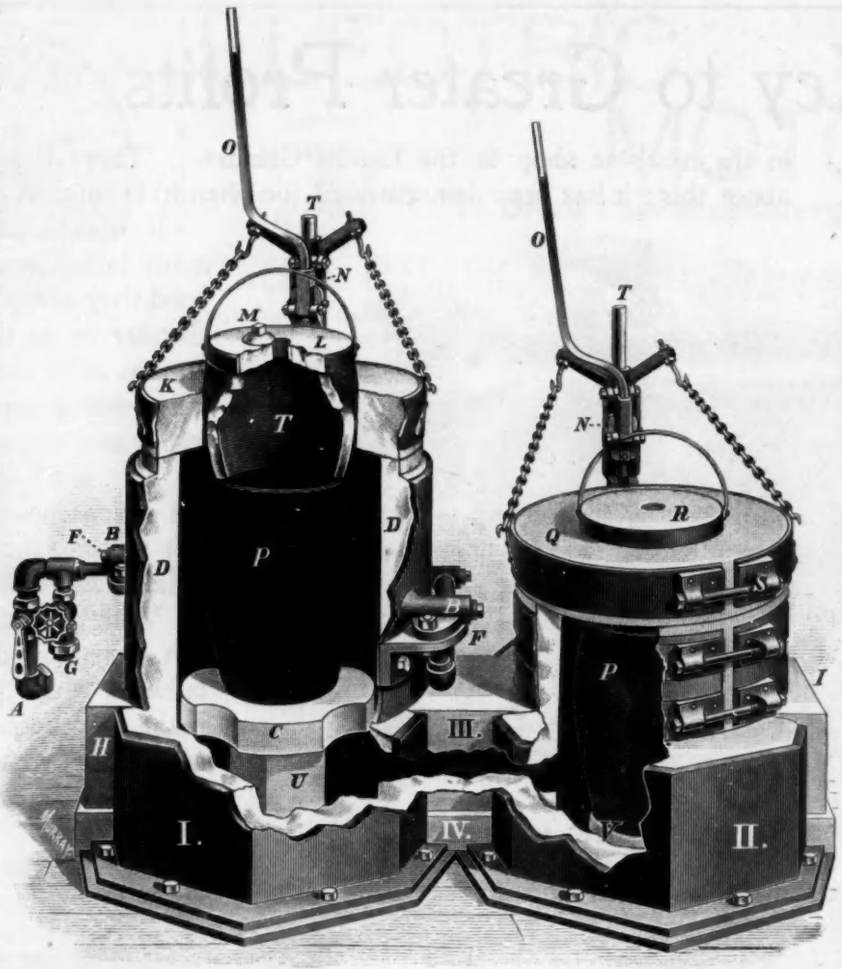
Walter H. Foster, Manager, New York. Hill, Clarke & Co., Boston and Chicago. C. W. Burton, Griffiths & Co., London. Ad. Janssens, Paris, Brussels. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels.

This Is Our Gas Blast Tandem Melter.

It is designed to reduce the time and cost of melting metals, by utilizing, in a second furnace, the heat that is usually wasted, up-chimney, in a single one, and that's just what it does.

One hundred pounds of Brass or Copper can be melted with a No. 40 Pot, in a No. 2 Tandem Down Draft Furnace, in just an hour and a half, starting cold. Subsequent melts can be made in forty-five minutes.

Here's how the thing is done: A crucible with full charge is placed in each furnace. The Melter (Fig. I), used in the regular way, melts its charge to a finish, and the crucible is removed.



The crucible placed in the "Pre-Heater" (Fig. II) is then transferred to the Melter, and its place is taken by a new charge, preferably in the hot crucible taken from the Melter.

The waste heat from the "Melter" heats the second crucible sufficiently to shorten, by fully one-third, the time required by the "Melter" to do its work, without an extra cent's worth of gas.

Ingots and solid pieces of metal can be piled up in the "Pre-Heater" without a crucible, and brought to a bright red heat preparatory for melting, the metal being kept below the melting point by raising the cover Q.

The "Melter," shown in the illustration, has a feeding funnel T, inserted in the cover, and resting upon the rim of the crucible, P. This prevents scrap from falling in around the sides of the crucible and forming slag, which is very destructive to the furnace lining.

If the melting of metals cuts any figure in the operations of your shop, it ought to be worth dollars to you to know more about this Tandem Melter. It will cost you only a letter of inquiry to get every detail.

If you have an unsolved problem involving the heating or melting of metals, we can almost surely help you to its correct and economical solution. We are specialists in this line, and if none of the machines we have already built is suited to your purpose, we can probably design and build one that will fully meet your requirements. Write to us.

Ask us about Fuel Gas Plants.

American Gas Furnace Co., 23 John Street, New York.

Chas. Churchill & Co., London. H. Glaenzer & Perreaud, Paris. Schuchardt & Schütte, Berlin, Cologne, Vienna, Brussels, Stockholm, New York.

We make the kind you need.

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Modern Style

Second-Hand Machinery

ENGINE LATHES.

36 in. x 16 ft. Fitchburg, compound rest.
32 in. x 18 ft. Fay & Scott, compound rest.
30 in. x 10 ft. David W. Pond, compound rest.
23 in. x 16 ft. Putnam style, R. & F. rest.
22 in. x 17 ft. Harrington, compound rest.
18 in. x 14 ft. Ames Co.'s, R. & F. rest.
18 in. x 8 ft. Flather & Co., plain rest.
16 in. x 6 ft. Blaisdell, R. & F. rest.
15 in. x 8 ft. Jones & Lamson, R. & F. rest.
14 in. x 6 ft. Blaisdell, R. & F. rest.
14 in. x 6 ft. Hendey, R. & F. rest.

PLANERS.

40 in. x 12 ft. Fitchburg, one head.
36 in. x 12 ft. Gleason, two heads.
36 in. x 10 ft. Pond Machine Tool Co.
30 in. x 10 ft. New Haven Co.'s.
26 in. x 9 ft. Ferris & Miles.
26 in. x 6 ft. Gleason.
24 in. x 6 ft. Hendey friction.
24 in. x 6 ft. Lathe & Morse Co.'s.
24 in. x 6 ft. Detrick & Harvey, open side.

DRILLS.

3-spindle, Slates, 13 in. swing.
3-spindle, Woodward & Rogers, auto. feed.
4-spindle, Jones & Lamson, extra heavy.
20 in. swing, Prentice, hand feeds.
30 in. swing, Prentice, complete.
34 in. swing, Blaisdell, complete.
42 in. swing, Prentice, stand. pat'n., complete.
Universal radial, 5 ft. arm, "Warrens."

MILLING MACHINES.

Brainerd, No. 3, universal, with large unv. head.
Garvin, No. 3, hand feed.
Garvin, Nos. 11, 12 and 15, auto. feed.
Bridgeport, heavy, back geared, auto. feed.
Brown & Sharpe, No. 4, heavy, auto. feed.
Brown & Sharpe, No. 1, universal.

SCREW MACHINES.

Bardons & Oliver, No. 2, wire feed, 29-32 in.
Bardons & Oliver, No. 3, wire feed, 5-32 in.
Bardons & Oliver, No. 4, complete, 1 9-16 in.
Jones & Lamson, "7X," fric. gears, 1 5-16 in.
Jones & Lamson, "8X," complete, 2⅛ in.
Hartford, full automatic, 2 in.

MISCELLANEOUS.

Shapers, 8, 10, 16 and 24 in. stroke.
Slotter, 13 in. stroke, Putnam Mach. Co.'s.
Bolt cutters, 1½ and 2 in., Acme, complete.
Pipe cutter, 6 in., Jarecki Co.'s, complete.
Brass finishers' Fox Monitor lathe, 15 in.
Power hammers, 200 and 300 lbs.

J. J. McCabe,

14 Dey St., New York.

BARGAINS IN NEW AND SECOND-HAND MACHINERY.

48 in. Bickford Boring and Turning Mill, 60 in. x 15 ft. Planer, 30 in. x 8 ft. Planer, 60 in. Boiler Makers' Drill, No. 2 Garvin Milling Machine, No. 3 Pratt & Whitney Screw Machine, No. 3 Windsor Screw Machine, No. 3 Bardons & Oliver Screw Machine. New Tools ready for delivery: 24 in. x 12 ft., 18 in. x 8 ft., 18 in. x 10 ft., and 15 in. x 6 ft. Lathes, and 16 in. Shapers.

Frank Toomey, 129-131 N. Third St., Philadelphia

IMMEDIATE DELIVERY.

Latest Improved Upright Drills.

7—20″ Wheel and Lever Drills.
3—20″ Wheel and Lever, Back Geared.
1—21″ Wheel and Lever, Power Feed.
4—24″ B. G. P. F. A. S.
3—28″ B. G. P. F. A. S.
1—40″ B. G. P. F. A. S.

The Lodge & Shipley Machine Tool Co.,

CINCINNATI, OHIO.

Second-Hand Machinery

ENGINE LATHES.

13 in. x 6 ft. Ames.
14 in. x 6 ft. Prentice.
16 in. x 6 ft. Ames.
18 in. x 12 ft. Bogart.
27 in. x 12 ft. Wood&Light.
16 in. x 8 ft. pattern mkrs.

SCREW MACHINES.

No. 2 Wire feed.
No. 2 P. & W., Plain.
No. 2 1-2, P. & W., wire feed.
No. 4 Windsor, plain.
No. 4 Windsor, wire feed, automatic.
No. 2 Niles, heavy.

PLANERS.

16 in. x 16 in. x 4 ft.
20 in. x 20 in. x 5 ft.
24 in. x 24 in. x 4 ft.
25 in. x 25 in. x 10 ft.
28 in. x 28 in. x 8 ft.
36 in. x 36 in. x 12 ft.
48 in. x 48 in. x 15 ft.
60 in. x 60 in. x 22 ft.
72 in. x 72 in. x 20 in., 3 hds.

SHAPERS.

9 in. Traveling head, Sellers.
13 in. Traveling head, Bement.
20 in. G. & E.

DRILLS.

6 spindle Quint.
Pond suspension.
22 in. G. & E., geared.
24 in. Ames, geared.
32 in. G. & E., geared.
32 in. Harris geared.
Combined Drill and Slotter.
4 spindle Ames.
Bicycle frame drill.

MILLERS.

Lincoln Type Miller, P. & W.
Hand Miller, Ames.
Special Cam Miller.
Double-head Cam Miller, P. & W.

MISCELLANEOUS.

34 in. Lead Lapping Machine.
No. 2 Water Tool Grinder.
Centering Machine.
24 in. Gear Cutter.
36 in. Hand Gear Cutter.
48 in. x 12 ft. Hor. Boring and Drilling Machine.
12 in. Splitting Shear.
Car mortiser and borer.

We have named above only our choicest tools. Write us for anything you want. Prices on application.

THE NILES TOOL WORKS CO.,

136-138 LIBERTY STREET NEW YORK CITY.

Modern Power Presses.

Second-Hand, A 1 Order.

1 No. 34 Toledo Geared Power Press.
1 D. G. 23 Ferracute Geared.
3 No. 75 Toledo Geared.
2 C. 4 Ferracute.
2 No. 21 Bliss.
3 No. 20 Bliss.
2 P. 2 Ferracute.
1 No. 1 Cady.

S. M. YORK CO., Cleveland, Ohio.

PUNCH PRESSES.

No. 19 and No. 20 Bliss.
No. 51½ Bliss, double column.
No. 75 Bliss.
No. 31 Toledo, double feed rolls.
D 33 Ferracute Heavy Screw Press.
6 Blake & Johnson Presses, No. 1½.

LARGE TOOLS.

42 in. x 12 ft. Springfield Engine Lathe.
42 in. x 19 ft. Worcester Engine Lathe, very heavy.
60 in. x 22 ft. New Haven Engine Lathe, triple geared.
6 in., 9 in., 10 in. and 12 in. Slotters.
Heavy Slab Miller, Beaman & Smith, 8 ft. table, vertical spindle.
60 in. Niles Pulley Boring Machine.
6 Radial Drills
Two-spindle Beaman & Smith Milling Machine.
36 in. and 60 in. Gould & Eberhardt Gear Cutters, automatic.
No. 6 Williams & White Bulldozer.
Prentice Bros. Suspension Drill.

UNIVERSAL GRINDERS.

No. 1 Diamond Universal Grinder.
No. 3 Landis Universal Grinder.
36 in. Springfield Water Tool Grinder.
Brown & Sharpe Cutter and Reamer Grinders.

MISCELLANEOUS.

Dayton Bicycle Tube Swaging Machine.
20 in. and 24 in. Fay & Scott Pattern Makers' Lathes.
Three-Spindle Baker Gang Lathe.

Marshall & Huschart Machinery Co.

62-64 S. Canal St., Chicago, Ill.

19 S. Water St., Cleveland, O.

Second-Hand Machinery

IN EXCELLENT CONDITION.

LATHES:

18 in. x 8 ft. Blaisdell.
16 in. x 6 ft. Reed.
16 in. x 6 ft. Porter.
15 in. x 6 ft. Porter.
12 in. x 5 ft. Silk.
10 in. x 4 ft. Frasse.
15 x 5 Speed Lathe.
1 16 in. x 5 ft. Friction head, Warner & Swasey monitor.
1 36 in. Putnam Pulley Lathe.
17 in. x 17 in. x 4 ft. Putnam Planer.
Hand Miller, Garvin.
Lincoln Miller, Pratt & Whitney.
12 in. x 5 ft. Turret Lathe.
No. 3 Power Press, R. & K.
1 No. 4 Garvin Miller.
1 100 ton Hydraulic Car Wheel Press.
1 36 in. Car Wheel Borer.
1 1 in. Double head Acme Bolt Cutter.
1 ½ in. 4-spindle Acme Nut Tapper.
Diamond Grinders.
25 Horse Power Motor.
25 in. Barnes Drill.
1 30 lb. Bradley Strap Hammer.

Also full line latest improved new machine tools.

J. B. DOAN & CO.,

68-70 South Canal Street, CHICAGO ILL.

Second-Hand Machinery

LATHES.

88 x 20 Cleveland, triple geared.
70 x 16 driving wheel.
62 x 10 New Haven pulley, triple grs.
53 x 20 Gay & Silver.
38-50 x 15 Gage, P. G., P. C. F.
40 x 14 N. Y. Steam Eng. Co., P. G., P. C. F.
37 x 13.6 New Haven, C. R., P. C. F.
30 x 22 New Haven, C. R. & P. C. F.
29 x 18 Ames, C. R., P. C. F., 3 in. H. S.
28-36 x 16 Putnam, P. G., P. C. F.
28 x 16 Putnam, C. R., P. C. F., A1.
28-42 x 10 Pond, C. R., P. C. F.
2-26 x 12 New Haven, C. R., P. C. F.
24 x 12 Sellers, C. R., P. C. F.
24 x 10 Fifield, C. R., P. C. F.
23½ x 12 New Haven, C. R., P. C. F.
20 x 11 Sellers, C. R., P. C. F.
19 x 8 Pond, and Lodge & Barker.
18 x 6 Eddy and New Haven.
17 x 8 Putnam, Johnson & Fifield.
16 x 6 & 8 Robbins, P. G., P. C. F.
4-15 x 6 Smith, P. G., P. C. F., 9-16 in. H. S.
14 x 6 Putnam, Prentiss and Pond.
13 x 5 & 6 Ames.
12 x 4 Chase, R. & F., A1.
No. 3, 15 in. Windsor universal Fox monitor.
15 x 6 Lodge & Davis Fox monitor.
15 x 5 American T. & M. Co. Fox.

PLANERS.

74 x 51 x 23.10 Betts Mach. Co.
48 x 48 x 12 Scott, two heads.
42 x 42 x 16 Bement, one head.
36 x 36 x 12 N. Y. Steam Eng. Co.
2-36 x 36 x 10 New Haven.
32 x 32 x 10 P. & W.
32 x 32 x 7 Betts.
28 x 28 x 8 Gleason.
26 x 26 x 6 Putnam.
25 x 23 x 5.10 Sellers.
23 x 23 x 4 L. W. Pond.
18 x 16 x 3½ Putnam, fine.
16 ft. Hilles & Jones plate.

MILLING MACHINES.

No. 6 B. & S., plain.
No. 4 Garvin, with centers.
No. 3 Kempsmith semi-univ., A1.
3 No. 3 Garvin hand.
2 No. 2 Garvin hand.
1 No. 1 Garvin hand.
No. 2 Ingersoll univ., B. G.
No. 1 B. & S. univ.
8 Lincoln pattern, all styles.
No. 0 Van Norman duplex, A1.
3 D. W. Pond index.

MISCELLANEOUS.

12 ft. Knowlton vert. boring mill.
2 51 in. Sellers vertical boring mill.
33 in. car wheel borer.
10 in. New Haven slotter.
6 in. Bement slotter.
6 ton Yale & Towne trav. crane, hand power.
3, 4 and 5 ton jib cranes.
No. 2 and No. 3 Merriman bolt cutters.
No. 2 and No. 3 Putnam bolt cutters.
Sellers twist drill grinder.
Nos. 4 and 5 Stow flexible drill.
38 in. New Haven drill, B. G. & P. F.
48 in. arm Betts radial.
Portable electric drill.
Shapers, 8 to 30 in. stroke.
2 No. 1 P. & W. screw machines, W. F.
No. 1 Garvin ditto, A1.
No. 1 Prentiss ditto, A1.
2 No. 2 Prentiss ditto, A1.
2 each 10 and 12 in. P. & W. plain.
5 No. 0 Hartford auto.
8 ft. Betts bending rolls.
Heavy boiler maker's punch.

We also have a large stock of other tools on hand.

Send for complete new and second-hand lists.

PRENTISS TOOL & SUPPLY CO.,

115 Liberty Street, New York City.

BUFFALO OFFICE—603 D. S. Morgan Bldg.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 22 NEW YORK, THURSDAY, JUNE 15, 1899 NUMBER 24

Published at 218 William St., New York
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

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Subscription Price.

$3 per year in advance, postage paid in North America.
$4 per year in foreign countries, postage prepaid.
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Railroad Men to Manage Railroads.

Wonder is sometimes expressed as to why the affairs of the Pennsylvania Railroad are so much better conducted than those of most other roads, and why it is so much more uniformly prosperous. The history of its late president, who died a few days ago, throws much light upon this question. Mr. Thomson was a thorough railroad man. As a boy he evinced a strong taste for and inclination towards railroading, and he steadily pursued a course which fitted him for the administration of a railroad's affairs. Of course the newspaper statements about his ability to "construct a locomotive from the crude iron to the finished machine on the track" are nonsense, but he did serve a special apprenticeship at Altoona, and his training was not in the direction of skilled stock manipulations, "deals" and in what passes for "financiering" and is often simple rascality, but rather it was designed to fit him to direct the actual management of a railroad, i. e., the commercial handling of passenger and freight traffic—keeping the wheels turning to good purpose.

He was no mere figure-head president. He did not gain the confidence of the Pennsylvania directorate by skill in manipulating legislators, in lobbying or wire-pulling, but by his knowledge of how to run a railroad and his devotion to the work of doing it.

Though his term as actual president was short, his service with the road in an administrative capacity was long, and he was preceded by similar men—men whose talents lay in the direction of simply managing railroads and who devoted themselves to that work. The fact that such men are chosen by the Pennsylvania directorate shows that the importance of such service is appreciated, and perhaps that is one of the reasons why the Pennsylvania road is so well managed and is so prosperous.

Horseless and Nameless.

The "Electrical Review" attempted the task of hastening the evolution of order out of chaos by offering prizes to those who should suggest the best names for what we variously and discordantly call autotruck, autocar, automobile, horseless carriage, autobat, etc., and awarded the first prize to "electromobile," whereupon one of the philologists is unkind enough to say:

"The 'Electrical Review' went to the length in April last of offering money prizes for names that would designate 'electrically propelled, self-contained vehicles for roads and streets,' and it has just awarded $10 to one man and $5 to another for suggesting the truly dreadful word 'electromobile.' The 'Electrical Review' might safely offer millions to anybody who would make a worse one. Besides involving all the crimes of which 'automobile' is guilty, 'electromobile' is of wearisome length, and the meaning it strives so feebly to express is so childishly obvious that the chances of the word's adoption are less than infinitesimal."

And thus we see that while the one man has the $10 and another $5 we still flounder and have on our hands nameless horseless vehicles.

To Boom Liquid Air in Philadelphia

Mr. Tripler recently gave one of his characteristic exhibitions at the Academy of Music, in Philadelphia, and following close after it comes the announcement of the organization in that city of a "Liquefied Air Power and Motor Company," capital $10,000,000, and "a limited amount of stock is now offered for subscription." It is gravely announced that: "So confident are those familiar with its (liquefied air) power and its adaptability to practical purposes that capitalists have resolved to have it applied to the running of stationary engines, street vehicles and freight trains, *thus saving the expense of* coal and much labor, and greatly promoting comfort and safety in travel. The resolutions of capitalists and the money of credulous investors unfortunately have little mechanical efficiency.

Vacation Work for Engineering Students.

The reproach of the summer season, of idleness, is being gradually removed from our higher institutions of learning. Those whose hearts have in the past ached to see these great educational plants lying idle for three or four months of the year, have been greatly cheered by the development of the summer school idea, especially as through it the advantages of these institutions have been thrown open to many who were barred from the regular university courses.

A late development aims at keeping the regularly enrolled students in engineering at profitable work during the summer season, through a plan which is so altogether admirable as to deserve general recognition.

We have received from Professor Hibbard, in charge of the School of Railway Engineering at Cornell University, a pamphlet entitled "Summer Vacation Work in Railway and Locomotive Shops," which sets forth the arrangements that have been made with certain locomotive works and railway superintendents of motive power, to take Sibley College students into their shops for the long summer vacation. The pamphlet is addressed to the students of the college, and is intended to present to them the gains to be derived from taking advantage of the arrangement. We do not need to repeat or summarize these to our readers, to whom they will be obvious; but to all, this idea in connection with engineering education will appear as a matter of much interest.

These students, it should be said, are not taken in as lookers-on, or learners, or anything of that sort. On the contrary, they go on the regular pay roll, and are paid what they can earn; though the aim is to give them the work from which they can derive the most profit. This work is usually that of helpers in the erecting shop, where the students assist the ma-

chinists in erecting, stripping or repairing locomotives. The scheme appears to have been first applied by Professor Hibbard when he was located at the University of Minnesota; though we presume it was first suggested by the practice of some schools of civil engineering in obtaining summer field work for their students in railroad surveying parties. Sufficient experience with it has accumulated to show that it is successful from the railroads' standpoint. The intelligence of the students and their natural desire to acquit themselves creditably, make them superior to the class of labor usually employed for the purpose, and the pamphlet gives extracts from employing superintendents of motive power showing that the students are profitable employees.

Professor Hibbard informs us that he has already placed sixty of the students of Sibley College for the coming summer. Whether the limit reached was due to a lack of applicants or of places does not appear; but we venture the assertion that these young men, especially such of them as have had no previous shop experience, will return to their university work in the fall with a degree of inspiration and enthusiasm for their work which they have not before known, and we shall be much surprised if their relation of their experiences to their fellows does not multiply the list of applicants when another year comes around.

This work is of course intended more especially for those students who expect to engage in railway engineering; but there is no reason why it should not be extended to many other lines of work, and we shall be disappointed if that is not eventually done. With all of a student's summer vacations made use of in this way, he would acquire an amount of experience during his four years' course which is by no means to be despised; while the contact with commercial work should do much to correct some of the unfortunate tendencies of school life. Entirely apart from this, the spirit shown in taking up work of this kind cannot do otherwise than commend those who have done it to employers when permanent employment is wanted. From all points of view the movement is so admirable that we confess to a feeling of enthusiasm over it. The chief question that will suggest itself about it is, Why has it not been done before?

Liquefied Air and Liquefied Steam.

The English daily papers—one of them at least—have been let loose on liquefied air. I have noticed for some time since the death of the late lamented Keely that on your side there was a void to be filled. This would be a poor world but for perpetual motion. If we are to believe all we hear of Mr. Tripler, he has stepped into the shoes of Keely, for he has invented a machine for compressing air, which, once it has been induced to manufacture about 3 gallons of it, will continue ever after to manufacture liquid air until the brake is applied to stop it. Now this same liquid air has slopped over the Atlantic, and has been worked up by a daily paper for all it is worth. Water and steam power have been relegated to a back seat, and there is to be no further use for coal; and even electricity, which we all know costs nothing to make, and was soon going to put a stop to such archaic things as steam engines, is also to be put on the shelf. All this, which is absorbed by the average reader as so much gospel, is painful evidence of the great ignorance of first principles which possesses most people. If we take steam and put it under pressure, we shall cause some of it to liquefy. If at the same time we abstract from it some of its heat by means of some less hot body, we shall perform this duty of liquefaction with much greater ease, and we can with the command of a sufficient amount of heat-absorbing material liquefy practically all our steam without exercising upon it any pressure whatever. I have myself manufactured many tons of water by liquefying steam, and by again applying heat I have succeeded in again vaporizing the liquid steam and generating power by the use of the enormous expansive force thus set free. I have applied this force to turn machinery for the grinding of corn, for the spinning of cotton and for drawing vehicles along rails. Is it not marvellous! Yet no one gives me any credit for doing this. I am told that the principle has been known for years, and that my results are only an improvement on some results obtained a century ago by some fellow named Watt, and that Watt would have done just as well as I can do, but he did not have the appliances which I can command.

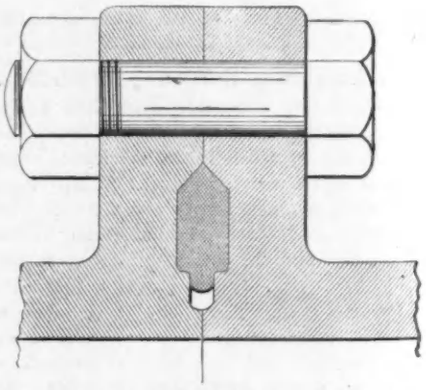
Yet here comes Mr. Tripler. In place of a chemical combination of oxygen and hydrogen Mr. Tripler takes a mechanical mixture of oxygen and nitrogen, having practically identical properties with my steam gas. The only substantial difference between his gas and mine is that the properties I have described as connected with my gas are exercised by his gas at temperatures much lower down the scale. In other respects there are no real differences. Such difference as there is demands machinery of more accurate make and stronger, for an equal result, than my machinery. There is also a far less choice of cooling materials than I am able to make use of. On one occasion, indeed, I employed the South Pacific Ocean—not all at once, but just any part of it which happened to be at hand at the moment. In this respect, therefore, my practice is wider and more general than that of Mr. Tripler. In no way, then, can he claim an advantage over my system. I see that he can carry his liquefied air in milk cans. Well, what if he can? Our milkman gives away a quantity of liquefied steam with every quart of milk he leaves at the door—says it enables him to sell cheaper, and it seems to have the valuable property of preventing some of that fatty material from collecting at the surface of the milk, if left standing for an hour or two.

Liquefied steam has many other advantages. At its usual temperatures it may be drunk without danger, and there are thousands of uses to which it can be put for which liquid air is unsuitable. As to power-production, liquid air is not in it. Why, then, all this fuss about liquid air? as though Mr. Tripler had discovered a new principle. He has possibly improved the apparatus for liquefying air, but here his useful work ends, and his liquid air can only have a very limited application; and when once vaporized, cannot be returned to the liquid state except by great expenditure of energy. Its use, therefore, must demand a great expenditure of fuel, and after all he must employ my liquid and my motor to produce his liquid. Yet the papers are full of Tripler, and say nothing of me. Is this because Tripler promises perpetual motion and I don't? Looks like it. W. H. Booth.

London.

A Pipe Joint for High Pressures.

During the discussion of Mr. Nagle's paper on "Pipe Flanges and Their Bolts," at the recent Washington meeting of the American Society of Mechanical Engineers, the following remarks were made by Mr. Halsey. They show a novel and highly successful form of pipe joint, and



CAPTAIN RAPIEFF'S PIPE JOINT FOR VERY HIGH PRESSURES.

one which we believe has not before been brought to public notice.

"The sketch, which is made from memory only, shows a form of joint with which I became acquainted some years ago, and which was so satisfactory under trying conditions that it deserves to be more widely known. It was invented by Captain Rapieff for use with the dynamite gun—that is, the gun commonly known as the Zalinski gun. The joint was applied to the gun itself (which is in sections) and throughout the pipe fittings. The re-

ceivers are sectional with numerous connections, and positive tightness and reliability are essential. The firing reservoir, the gun and the intermediate connections operate under a pressure of 1,000 pounds per square inch, while the compressor, the storage reservoir and their connections operate under 2,000 pounds.

"The sketch shows a section of the joint. A groove of the section shown is turned in the face of each flange, a surplus or 'overflow' space being provided below. In the space formed by the grooves a strip of soft round rubber is inserted, the cross sections of the groove and rubber being so proportioned to each other that when the joint is closed the rubber will occupy part of the overflow space. The rubber used is not a continuous ring, but is cut from a long strip with a scarfed joint where the ends meet.

"It will be seen that the pressure coming down the joint drives the rubber into the angle at the top and that leakage is practically impossible. The grip of the bolts is not relied upon to retain the rubber by friction, as with the ordinary gasket. The joint is metal to metal, and the pipe sections may be gotten out to defined lengths—a feature that is occasionally useful. In the case of the gun, an additional feature of great value is that the tightening of the bolts does not, as with gaskets, tend to throw the sections out of line.

"As stated, this joint was used in a great number of cases and I was assured that failure with it was unknown—positive tightness being expected and obtained as a matter of course."

Commercial Review.

NEW YORK, SATURDAY EVENING,
June 10, 1899.

MOTORS AND DYNAMOS.

While demand for electrical machinery is still heavy, several sellers consulted find it somewhat less so than a few weeks ago. The last few days of hot weather particularly seem to have wilted down the market. We fail to hear of many new contracts for complete equipments. The quiet season for electrical machinery is supposed to begin in May or June and to last till August or September. There is a large amount of inquiry, nevertheless, some of which will remain pending until the fall. Indeed, one company reports a greater amount of estimating at present than ever before. This bodes well for work during the latter part of the year.

The General Electric Company's sales are now averaging half a million dollars a week. Tnis is at the rate of a yearly total of $26,000,000, which as compared with $17,431,327, the company's orders for the fiscal year ending January 31, 1899, indicates a remarkable expansion of business. The General Electric Company received the contract for the generators to go with the two big E. P. Allis engines which are to be installed in the plant of the Boston Elevated Railway Company.

Motors for direct application to machine tools are a specialty with certain companies. The Bullock Electric Manufacturing Company, which makes this type of motors, is receiving an active inquiry for them and has many German orders. An excellent demand is also coming to the General Electric Company, which has taken up that line of manufacture. Some of the other companies which build motors extensively assume to consider it unwise to devote much attention to the direct driving of tools, maintaining that there is no great demand for the system and that the electrical operation of tools requiring less than five or ten horse-power is uneconomical unless the machines be connected in groups. One seller states that the business of this nature which he receives is forcibly thrust upon him.

Prices of electrical machinery have lately been advanced radically. The rising movement is much more in earnest than that which took place in some quarters last winter when copper first went up. The electrical companies realize that they have entered an epoch of high cost of material with a vengeance, and must do something to save their dwindling percentages of margin on finished products, however much it may frighten customers. Following the 10 per cent. advance made by the General Electric Company a month ago on all lines but incandescent lamps, that company added another 5 per cent. June 1, with the same exemption, and will not unlikely tack on 5 per cent. more in a week or ten days. The Crocker-Wheeler Company has advanced prices 15 per cent. inside of thirty days past. The Bullock Electric Manufacturing Company stiffened up 5 per cent. about the middle of May, and other companies have made important changes.

Electrical machines for ventilating and for marine purposes are now in season. The C & C Electric Company reports many orders in those lines. Four special motors have been ordered for ventilating purposes in the New York Post Office; two special double commutator variable speed motors of 10 and 20 horse-power for the Dun Building, New York, and two special slow-speed motors for the Jersey City Free Library. Orders are now on hand for eight or ten generating sets for yachts, tugs, etc. Among other recent sales of the company are a small power plant for a gold mine in Colorado, including an electric hoist; three 25 horse-power motors for direct connection to machines of the Joseph Bancroft & Sons Company, cotton goods manufacturers, Wilmington, Del., and seven special elevator motors for the Waygoods elevator firm, of London.

The Standard Oil Company has ordered for its Long Island City plant eight Eddy motors aggregating about 225 horse-power.

The Bullock Electric Manufacturing Company is sending a great deal of material to England. Much of it is for printing press work, in both newspaper and job offices. The points of destination are London, Birmingham, Manchester and elsewhere.

A New York export firm has received an order for an electric light plant, valued at $12,000, for a town near Orizaba, Mex.

An electric power plant of about 100,000 horse-power capacity will, it is said, soon be erected by the Shawinigan Water & Power Company, of Montreal, Canada, at the Shawinigan Falls, about seventeen miles below Three Rivers.

Few of the dynamo and motor manufacturers seem to cherish the intention to exhibit at the Paris Exposition. That the General Electric and Westinghouse Companies will do so goes without saying. Inquiries addressed to representatives of the Crocker-Wheeler, C & C and one or two others elicited negative replies, and it was not definitely known whether the Bullock would or not, though it was thought that they might. An argument against exhibiting which is offered by one authority is the fact that Continental tariffs render the trade there less lucrative, and therefore less worthy of cultivation, than the English.

MISCELLANEOUS.

The East Jersey Water Company, Little Falls, N. Y., has ordered three 250 horse-power Heine boilers in addition to the two of the same size and make which are now being erected. These boilers will be used in connection with pumping apparatus arranged according to the Riedler system for direct driving either by turbine water-wheel or by steam engine connected to the same shaft.

The prices of boilers are still strengthening. One water-tube boiler company has lately added 5 per cent. to the advance of about 25 per cent. which it had already made. A boiler manufacturer recently asked of several steel mills quotations on plates for deliveries from September to November and received replies from them saying that if his order suited them they would quote. Some mills, however, are naming deliveries as late as next spring.

The Buffalo Forge Company finds that business has opened up well in the New England territory. An unusually heavy demand for heating and ventilating and other plants is now being received from mills in that region.

The Albany Boiler Works, which since their conflagration bought the shop of the Franklin Iron Works, on Green Island, opposite Troy, N. Y., are crowded with work, and have leased outlying ground with the buildings thereon for a sheet iron and tank extension.

Information emanates from General Manager Ronayne, of the New Zealand

Railway Department, that $1,000,000 is about to be spent on new cars, locomotives and other improvements. It is believed that this opens an opportunity to American manufacturers.

The Robert Poole & Son Company is reported to be sending to the Kaltschugin Brass & Copper Company, of Moscow, Russia, a large amount of rolls, gearing, shafting for rolling mill, the first shipment having amounted to $30,000.

The Morgan Engineering Company is building a large slabbing mill and accessories for the Nicopol Mining & Metallurgical Company, Mariopol, South Russia.

It is reported from Philadelphia that the deal between Vickers' Sons & Maxim, of England, and the Cramp Ship & Engine Building Company is off, owing to the refusal of the former to pay 90 for the Cramp stock.

The Brown Hoisting & Conveying Machine Company has shipped to La Société d'Ougree, Liege, Belgium, a crane which occupied six cars in transportation to the sea coast.

MACHINERY EXPORTS FOR APRIL.

The "Monthly Summary of Commerce and Finance," from the Bureau of Statistics, Treasury Department, for April, 1899, shows increases over the corresponding month of 1898 in most of the classified lines of machinery. In several cases, however, the shipments were lighter than for March of this year.

Metal-working machinery exports for April, 1899, amounted to $578,151; for April, 1898, $390,213. For March, 1899, they have previously been reported, $638,664. For the ten months ending April, 1899, they were $5,410,720; for the ten months ending April, 1898, $3,703,173.

Electrical machinery exports were: For April, 1899, $195,955; April, 1898, $185,314; March, 1899, $254,092; ten months ending April, 1899, $2,276,694; ten months ending April, 1898, $1,702,812.

Printing presses and parts thereof: April, 1899, $107,617; April, 1898, $68,915; March, 1899, $127,259; ten months ending April, 1899, $696,868; ten months ending April, 1898, $762,945.

Pumps and pumping machinery: April, 1899, $255,229; April, 1898, $160,246; March, 1899, $333,006; ten months ending April, 1899, $2,229,236; ten months ending April, 1898, $1,667,734.

Locomotive engines: April, 1899, 42 in number, at $365,545 in value; April, 1898, 29, at $191,764; March, 1899, 30, at $254,032; ten months ending April, 1899, 414, at $3,798,219; ten months ending April, 1898, 366, at $2,983,082; ten months ending April, 1897, 278, at $2,616,528.

Stationary engines: April, 1899, 59 in number, amounting to $42,666; April, 1898, 44, at $48,029; March, 1899, 38, at $19,222; ten months ending April, 1899, 416, at $257,097; ten months ending April, 1898, 475, at $355,458.

Boilers and parts of engines: April, 1899, $95,574; April, 1898, $46,986; March, 1899, $81,508; ten months ending April, 1899, $961,071; ten months ending April, 1898, $726,470.

Sewing machines and parts thereof: April, 1899, $339,354; April, 1898, $242,536; March, 1899, $400,780; ten months ending April, 1899, $2,621,687; ten months ending April, 1898, $2,468,920.

Typewriting machines and parts thereof: April, 1899, $281,674; April, 1898, $206,005; March, 1899, $309,611; ten months ending April, 1899, $1,965,753; ten months ending April, 1898, $1,547,220.

Shoe machinery: April, 1899, $47,614; April, 1898, $81,536; March, 1899, $93,492; ten months ending April, 1899, $711,706; ten months ending April, 1898, $722,274.

CHICAGO MACHINERY MARKET.

As compared with a month or two ago, there is a lull in the machinery market. An old machinery man, one who has lived through a number of so-called booms, says that after a period of excessive activity a dull season usually ensues, after which a steady trade springs up. Reasoning from analogy, he says that in the early fall he looks for an increased business, which will have in it the elements of permanency. The explanation he offers is that the first flush of activity includes the equipment of quite a number of new plants, as was instanced early last winter. Those equipments are completed and the lull has come. In a few months will begin the trade of keeping up the various equipments on their enlarged scale and it will require a larger amount of machinery than before. On that hypothesis, the sting is wholly removed from whatever comparative quiet may now exist.

And the point is made that ordinarily the present state of trade would be regarded as very satisfactory. May was one of the best months of the year among the machinery men. June has opened more leisurely, but not wholly without life and spirit. Some factors in the trade are of the opinion that the advancing prices of tools are responsible for the slowness of buying. There are many inquiries which are not followed by the expected orders. The prices quoted in response to inquiries are higher than buyers expected, and often when, after delays, orders are given, the price has in the meantime advanced, and the purchaser, unreconciled, declines to complete the transaction. Whether he has gone elsewhere for his machinery or concluded to wait for a time until the seller moderates his estimate of values is past finding out. But it is regarded as a little curious that while the price of iron and steel has advanced from 75 to 140 per cent., and customers are taking the material as keenly as ever, an advance of from 15 to 25 per cent. in machinery should have the dulling effects alluded to.

A traveling salesman for a large machinery seller says he observes a notable change in the repair trade. Formerly the little repair shops in the country were all busy. They made the repairs on reapers and mowers, and in fact on all classes of machinery used in the vicinity of their shops. Now much of this work is sent direct to the manufacturer's works, where large repairs shops have been erected, and where, with larger and more improved machinery, the old machines can perhaps be more expeditionsly and thoroughly repaired.

Agricultural implement shops, in view of the somewhat unfavorable crop reports, are checking their buying, especially of machinery. But there is generally a very fair trade in all kinds of machine tools. One of the recent sales was for about sixteen tools, bought by the Swift Packing Company for the equipment of its new repair shops in Kansas City.

The Pratt & Whitney Company reports a very good trade during May. One of its recent sales was for twenty-six machines, bought by an Ohio manufacturer.

Hill, Clarke & Co. report May one of their best months since 1892. Business was made up of moderate-sized lots, but the aggregate number was unusually large.

Quotations.

NEW YORK, Monday, June 12.

Iron — American pig, tidewater delivery:—

Pennsylvania irons:	
No. 1 X foundry	$17 50 @ 18 00
No. 2 X foundry	17 00 @ 17 50
No. 2 plain	16 50 @ 17 00
Gray forge	16 00 @ 16 50
Alabama irons:	
No. 1 foundry	17 75 @ 18 25
No. 2 foundry	17 25 @ 17 75
No. 3 foundry	16 75 @ 17 25
No. 1 soft	17 75 @ 18 50
No. 2 soft	17 25 @ 17 75
Foundry forge	16 25 @ 16 75

Bar Iron—Refined: Mill price in carloads on dock, 1.80c., upward; from store, 2.00c., upward. Common, from store, 1.90 @ 1.95c.

Tool Steel — Base Sizes — Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c., and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 2.30c., upward.

Cold Rolled Steel Shafting—Base Sizes, from store, in small lots, 3¼ @ 3½c.

Copper—Carload lots, Lake Superior ingot, 18 @ 18¼c; electrolytic, 17⅛ @ 17½c.; casting copper, 17 @ 17¼c.

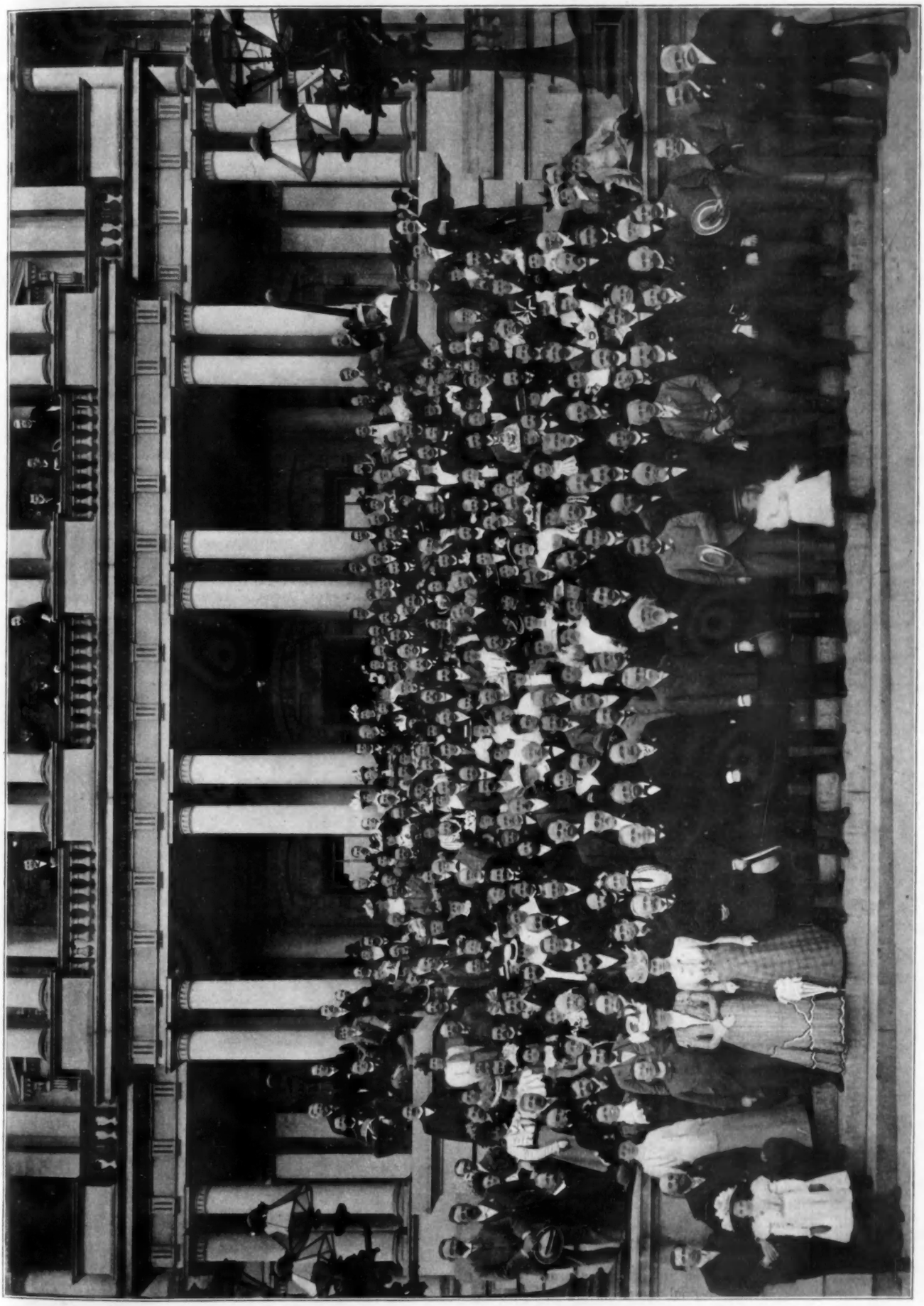
Pig Lead—Carload lots, 4.45 @ 4.47½c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 25.85 @ 25.90c., f. o. b. New York.

Spelter—Prime Western, in carload lots, 6⅛ @ 6⅜c., New York delivery.

Antimony—In cask lots and over, Cookson's, 11c.; Hallett's 9⅞c.

Lard Oil—Prime city, ice pressed 41 @ 43c. for the leading brand, in wholesale lots.



MEMBERS AND FRIENDS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS IN FRONT OF THE WAR, STATE AND NAVY BUILDING, WASHINGTON, MAY 10.

Some Interesting Tools and Methods Seen at the Shop of the Boyer Machine Co.

The products of this St. Louis (Mo.) shop are more widely known in connection with the Chicago Pneumatic Tool Company, the sales agents, than with the name of the manufacturer. They comprise the Boyer pneumatic hammers, piston air drills, portable riveting machines,

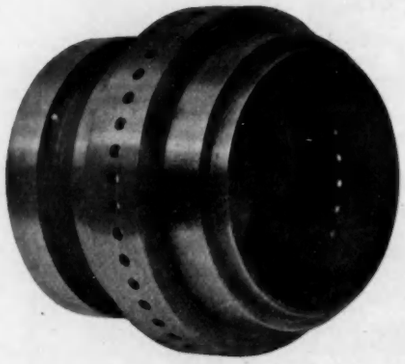


FIG. 1. VALVE OF THE BOYER HAMMER.

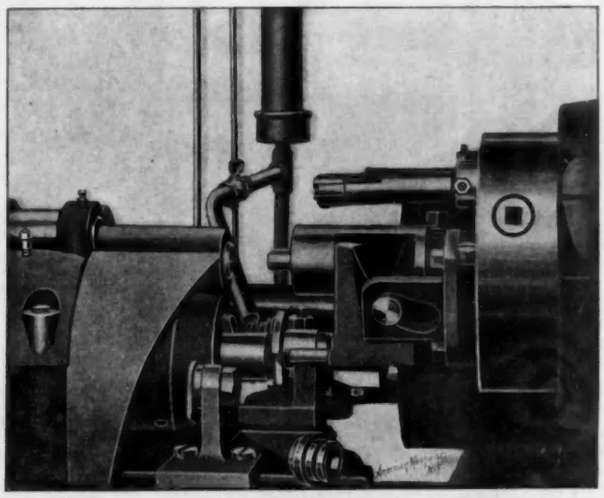


FIG. 2. INSIDE VALVE TOOL IN PLACE ON TURRET LATHE.

speed indicators, and other specialties. The machines are beautiful pieces of design and workmanship, and are constructed by very advanced methods, the equipment of the shop being of the best, and the special tools of the most workmanlike construction.

One of the most interesting pieces of work is shown in Fig. 1, which is from a photograph of a valve of the pneumatic hammer. It is made of tool steel and is hardened and ground on its outside surface. It is made from the solid bar in a Cleveland Machine Screw Company's automatic turret lathe, the piece being made complete, so far as lathe work is concerned, before cutting from the bar. In order to keep down vibration in the completed hammer it is necessary to keep the weight of the valve down to the lowest point possible, and the collars and grooves seen upon the outside surface are therefore repeated in reverse upon the inside surface. The largest diameter of the valve is 2½ inches, while the greatest thickness is but 1-16 inch, and the cheap production of such pieces in quantities, from tool steel, and of a high degree of accuracy will be seen to offer some scope for good tool design and practice.

The production of the outside profile calls for no methods or tools which are unusual to turret lathe practice, circular forming tools held in the cross-slide being in fact used, but the making of the inside profile to follow the outside is not so easily accomplished. The means by which this is done is shown in Figs. 2, 3, 4 and 5. The front bearing of the lathe headstock will be seen in Fig. 2 at the left, and the turret, which turns on a horizontal axis, at the right. The cutting tool for the inside profiling is in line with the work, ready for the inward movement. The profile edge is, however, turned away from the observer, the back side of the tool being in view. At *a*, Fig. 3, is the projecting end of the bar of stock which has already been drilled, the chuck being shown in outline. Bolted to the headstock is an arch-shaped casting, having a bushed hole *b*—this casting being more clearly shown in Fig. 2. In line with this hole and fitted to enter it is a stiff pin *c*, formed on the end of a sleeve *d*, which is

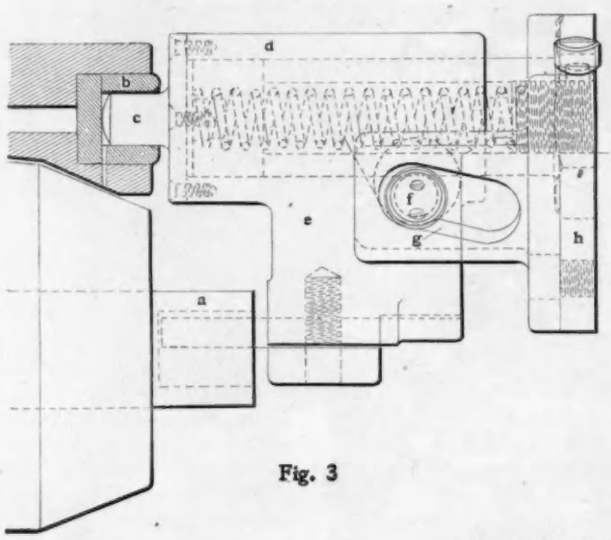


Fig. 3

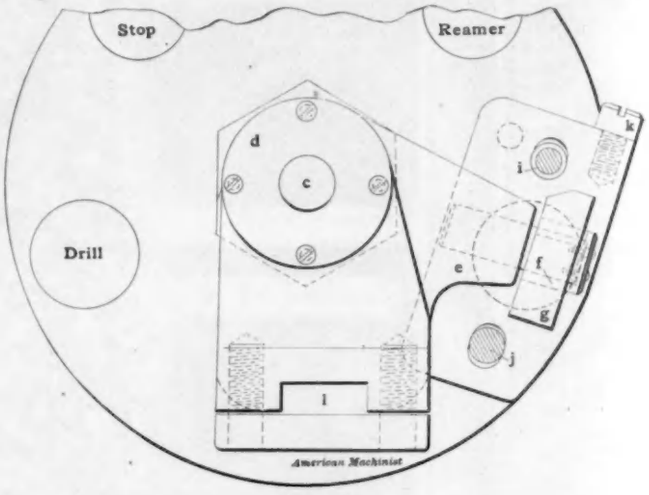


Fig. 4

TOOL FOR MAKING INSIDE CUT OF FIG. 1.

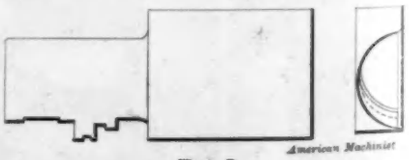


Fig. 5

BORING TOOL OF FIGS. 2, 3 AND 4.

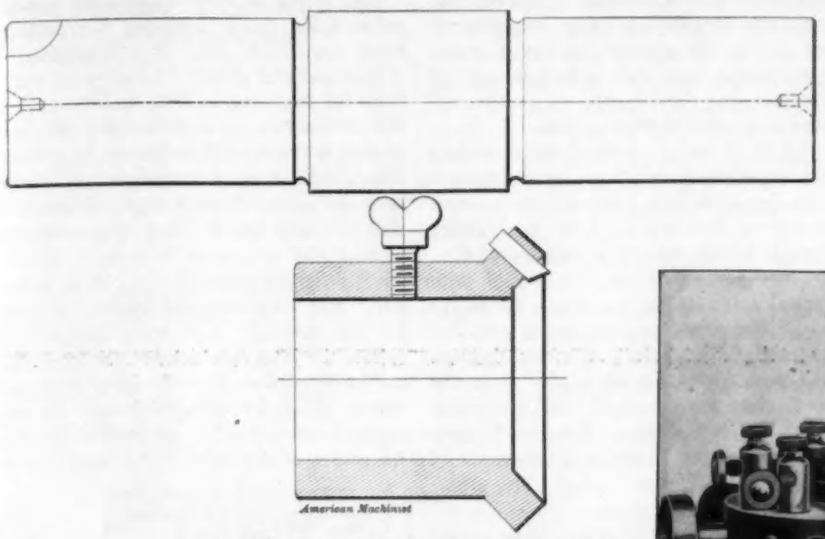


FIG. 6. MANDREL AND CENTERING FIXTURE FOR GRINDING VALVE SHOWN IN FIG. 1.

fitted to slide and turn on a stout pin secured to the center of the turret—a spring within the sleeve pressing it away from the turret. The sleeve carries an arm *e*, which, in front, is fitted with a roller *f* engaging with a cam *g* attached to the turret. As the turret feeds forward, pin *c* first enters hole *b*, the tool entering the hole in the work. When pin *c* bottoms in hole *b*, the forward progress of the sleeve *d* and of the tool is arrested, but the feed of the turret continuing, the cam *g* acts on roller *f* and swings bush *d* and arm *e*, and with them the cutting tool, around the pin *c*, the tool being thus forced into the work to cut the internal groove. On the completion of the cut the withdrawal of the turret reverses these motions—the roller being forced up the cam groove by the spring within the sleeve, thus insuring the tool being withdrawn radially from the groove cut by it before being moved endwise out of the hole. In addition to accomplishing the required movements, the tool will be seen to be excellently adapted to resist the strain of the cut, the sleeve *d* being supported during the cut at both ends and close to the work.

Fig. 4 shows the fixture when looking endwise of the lathe spindle, the outline of the turret being included. The cam *g* will be seen to have an intermediate piece *h* between it and the turret. This piece has a stem to enter the turret hole, and a

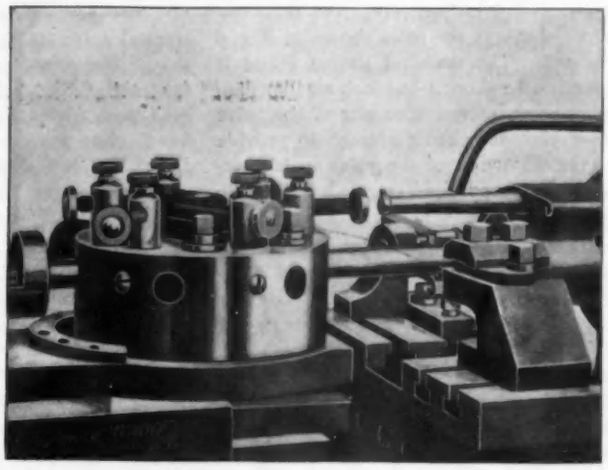
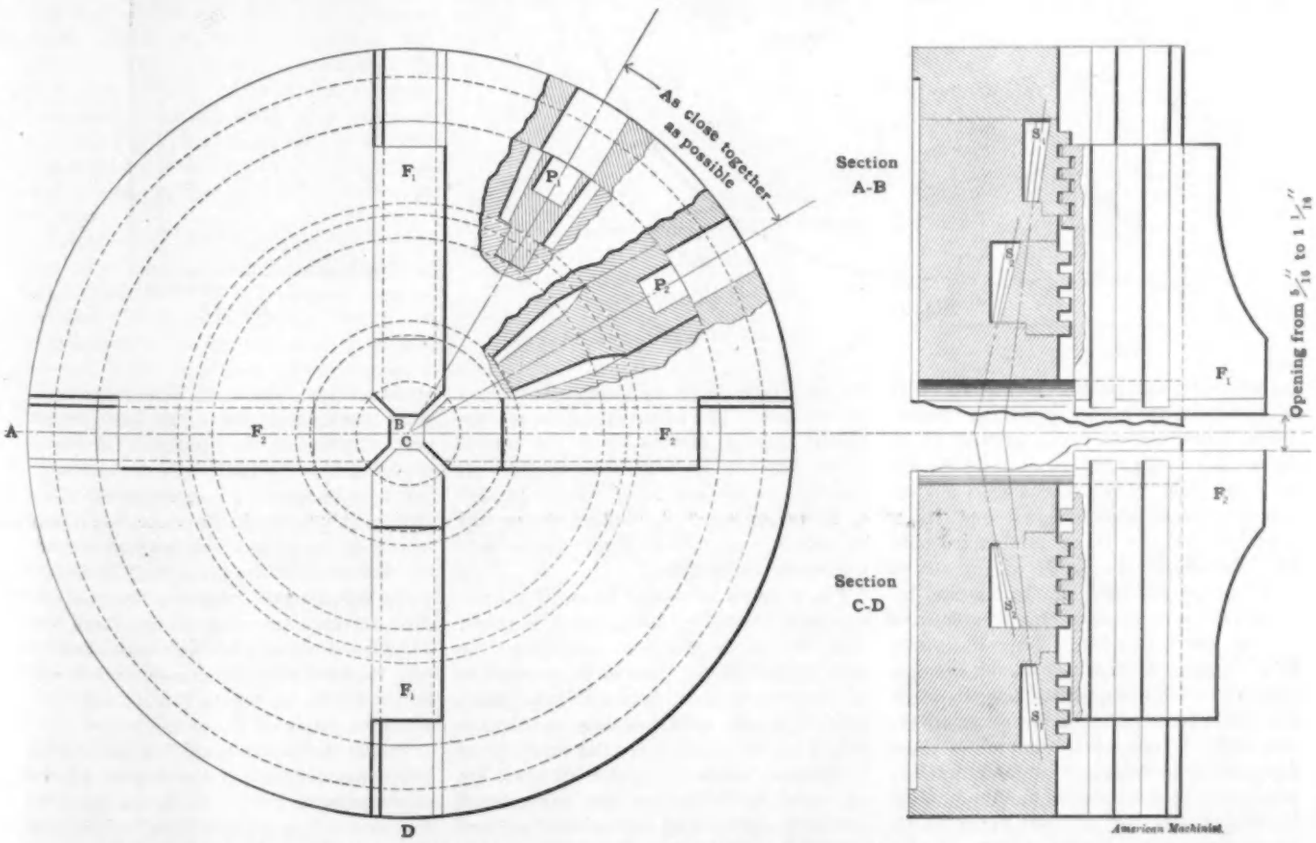


FIG. 7. INDEPENDENT STOPS ADDED TO AN OLD TURRET LATHE.



Pinion P_1 Revolves Scroll S_1, Which Operates Jaws F_1. Pinion P_2 Revolves Scroll S_2, Which Operates Jaws F_2.

FIG. 8. SEMI-UNIVERSAL FOUR-JAW CHUCK.

dowel pin to locate it properly. The base of cam *g* slides on two screws, *i* and *j*, while the projecting head of screw *k* serves to adjust the tool for depth of cut. The tool is carried in recess *l*, and is shown in detail in Fig. 5.

The valve will be seen to be very slender, and after being hardened it is naturally out of round. Were it forced on a mandrel for grinding, it would obviously be distorted and would not be round after grinding. To meet this condition of things the tools shown in Fig. 6 are used. The mandrel shown above is ground to be about 1-100 inch smaller than the smallest interior diameter of the valve —this allowance being enough to provide for the distortion of the valve in hardening. The mandrel is warmed sufficiently to melt pitch, and pitch in powdered form is sprinkled on it. A centering sleeve, shown below the mandrel, ground to fit the end portions of the mandrel, is slipped on at one end. The valve is then put on over the melted pitch and a second sleeve is put on after it. Three bevel-ended pins will be seen in the flange of the sleeve which center the valve on the mandrel by its outside—averaging up the irregularities due to the hardening. With the valve properly located the whole arrangement is dipped in cold water, which sets the pitch and secures the valve ready for grinding. The sleeves and valve are put in place with the mandrel in a suitable fixture, which locates the valve at a definite point on the mandrel, and obviates the repeated adjustment of the reversing stops on the grinding machine, which would be necessary without this provision. These mandrels are provided in large numbers so that the grinding operation once begun is continued without interruption. After grinding, the valves are, of course, removed by again warming them.

Fig. 7 shows a method of providing existing plain turret lathes with separate stops for each tool. Several such lathes have been thus equipped in the Boyer shop, and with a decided increase of convenience in setting up. A set of substantial posts will be seen to be put in the top of the turret—a post being provided for each turret hole. A screw through each post forms the adjustable stop, the fixed stop being a stiff rod projecting from the headstock. The fixed stop carries an index finger, and the heads of the adjustable stops are graduated to read to .001 inch. The adjustable stops are not readily placed directly over the turret holes, but are as near that location as possible. Each one is of course parallel to its turret hole. A binding screw will be seen in each post to secure the adjusting screw in position.

Fig. 8 shows what may be called a semi-universal four-jaw chuck, which is found very useful in working up square or octagon bar stock. It will be seen to be of the scroll type, but with two independent scrolls, each operating the diametrically opposite jaws. On the insertion of a piece of stock the pairs of jaws are tightened in succession, the work being correctly centered in both directions, and all jaws gripping regardless of the stock being out of square or of varying size.

Figs. 9 and 10 show a still more special turret lathe chuck, intended for drilling holes near each apex of a triangularly-shaped piece of plate. The piece of work is dotted in position in Fig. 9. The center line of the lathe is at *a*, which is also, of course, the center of the hole to be drilled. The piece of work is gripped by three jaws *b*, which draw it back against the pins *c*. Referring to Fig. 10, a revolving piece *d* will be seen to be mounted eccentrically in the body of the chuck, index pin *e*, and three hardened bushes *f* serving for the spacing. This revolving piece *d* carries the jaws *b*, which are connected together by a piece *g* in the interior of the chuck, the jaws being tightened by the squared screw head *h*, projecting through the center of the work. The jaws *b* have small pinions *i* cut upon their inner ends, these pinions engaging with a loose master-gear *j* carried by the piece *g*. The object of these gears is to enable the piece of work to be inserted and removed. This obviously could not be done by simply loosening the grip of the jaws on account of the jaw heads projecting over the work, but by first loosening the grip and then turning any one of the jaws half around the other jaws will turn likewise, and, the back side of the jaw stems having no heads, the work may then be freely inserted or removed.

It was the products of this shop which led "Engineering," of London, to a burst of enthusiasm not many weeks ago over the association of perfection of fit and alignment in acting surfaces with complete lack of polish in non-acting surfaces.

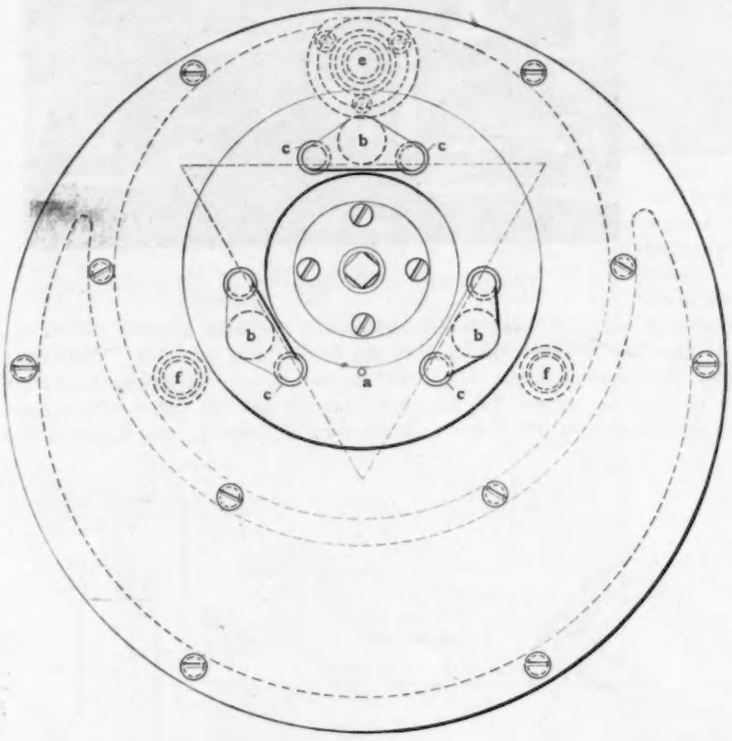


Fig. 9

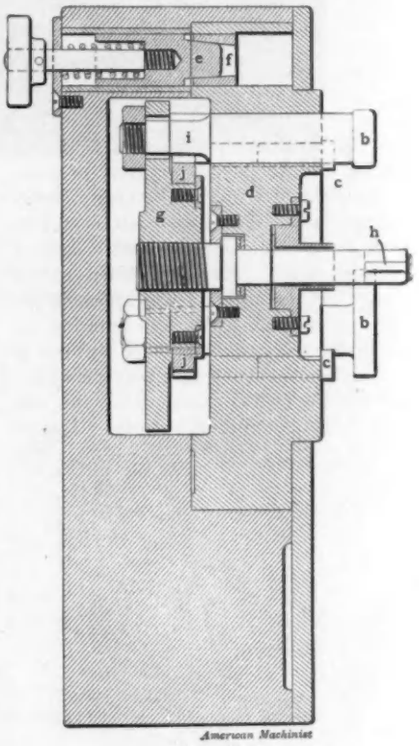


Fig. 10

SPECIAL TURRET LATHE CHUCK.

Machine Tools—VIII.

BY JOHN RICHARDS.

BEARINGS.

This subject can be preceded by some general propositions as follows: The quality of machine tools may be said to depend upon the accuracy of their movements. It is to this feature that both strength and good fitting are directed.

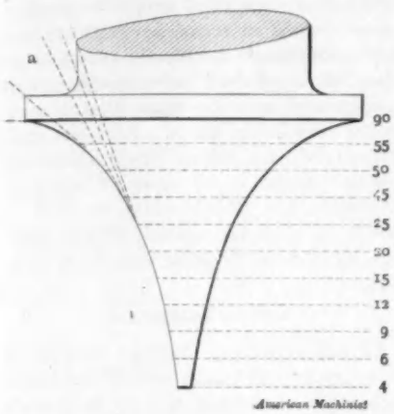


Fig. 58

All movements are guided by bearings, rotary and continuous, or flat and reciprocating. The former are the most perfect, because produced by turning and boring, in which operations either the work or the tools are revolved and guided on centers with a degree of truth not attainable by means of slides and reciprocating movement. These two kinds of bearings are, therefore, quite different as to their truth, even if we include flat or sliding bearings held in contact by gravity, as in the case of planing machine tables, and even these reproduce their own errors in straightness and alignment, due to bad construction or wear.

Cylindrical bearings are easy to produce and difficult to compensate. Flat bearings are difficult to produce and easy to compensate. The difference in respect to compensation is obvious as a principle, but not plain as a fact. Two flat faces can be adjusted normally one upon, or toward the other, but cylindrical faces cannot be adjusted concentrically, that is, the faces cannot approach each other uniformly or normally, except by tapering forms adjusted longitudinally.

Friction, the cause of wear, is a resultant of pressure, and is practically independent of velocity. The effect of pressure is inversely as the area of the surfaces in contact; hence, an increase of the surfaces of bearings diminishes the friction, wear and the amount of heat generated accordingly. This seems a simple proposition, but like many other things it had to come to recognition by a tedious course of evolution. It is not long since the time when the surfaces of bearings were reduced to avoid friction. There were two reasons for this. One, a disregard of the theory of friction and a common belief that velocity was the main cause of friction; the other, the want of means to fit large surfaces with the required truth. For these reasons journals were made as small as possible in diameter, and small points introduced whenever practicable. Guiding ways or sliding bearings were narrow and their contact area reduced to its smallest limit.

Another reason for small bearing surfaces was the flexure of framing. An increase of area does no good unless there is uniform contact, and this is dependent on either absolute rigidity, or pivoted bearings. Now all this is changed, and the trend of practice is to greatly increased areas in bearings of all kinds, with a result that is astonishing. Mr. George W. Dickie, chief engineer of the Union Iron Works, at San Francisco, recently remarked: "The speed factor is nearly eliminated in our work. We consider only the economical rate of revolution for machines. We make small engines to run at 700 revolutions per minute and think nothing of it." Mr. Irving M. Scott, managing director of the same works, when in England some years ago, had a consultation with Mr. Brotherhood, of London, respecting his high-speed engines, and inquired how the bearings were maintained. Mr. Brotherhood's answer was in one word—"Surface."

These several propositions respecting friction and surface in bearings are no doubt all correct in principle, but wrong in terms. The area in contact, called surface, is not in one case in ten a problem of surface, but one of fitting, and if flexure is substituted for surface it would be nearer the fact. Flexure is an insidious thing existing often where not expected and present nearly always in a degree that destroys a fit in bearings. There is no use in extending bearing surface, and, indeed, harm in doing so when flexure prevents a fit.

Those who are skeptical about the spring or flexure in shafts and spindles can gain a lesson from an overhung crank of a steam engine. By observing the center in the end of the crank shaft of a loaded engine, even one of the heaviest proportions and well made, one will be amazed to find the center describing a circle that precludes the possibility of the main bearing fitting in its seat so as to evenly distribute the pressure. The slightest bend will destroy the fit, disperse the film of oil between the surfaces and reduce the effective bearing area to a mere fraction of the nominal bearing.

This suggests increased diameter for the spindles and shafts of machine tools which are especially subjected to severe strains by the resistance of the work and the lateral thrust of gear wheels of small diameter, especially miter or bevel wheels employed as last movers, as in the case of drilling machine spindles.

Just at the time of writing this there came under notice a radial drilling machine made about ten years ago. It had a span of 6 feet, a sector sole plate that would weigh two tons or more—a formidable machine in appearance, but with a spindle only 2¼ inches diameter! Not

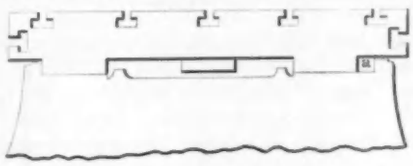


Fig. 59

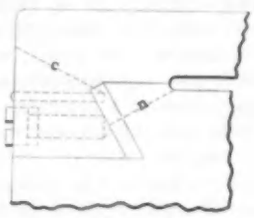


Fig. 62

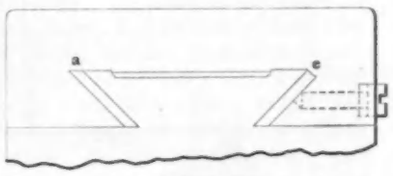


Fig. 60

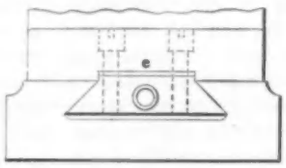


Fig. 63

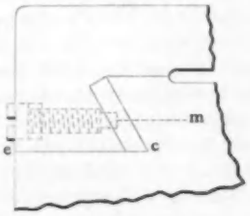


Fig. 61

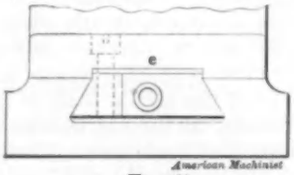


Fig. 64

GIBBED SLIDES OF MACHINE TOOLS.

only this. The driving gearing consisted of three shafts through which the highest power was transmitted from back gearing at the floor. These shafts were only 1½ inches in diameter, two of them about 5 feet long, connecting by three pairs of wheels interposed between the first and last movers, so that in boring and facing with the machine it would jump through ten degrees of arc, if the tool was released.

If the spindle of this machine had been made three times as large, or say, 4 inches in diameter, and the back gearing had been put on the main spindle, the functions and place of the machine in the shop would have been wholly changed and the original cost would not have been increased 20 per cent., perhaps not 10 per cent.

Machine-tool makers have in late years much increased the area of bearings and the diameter of shafts and spindles. Lathe spindles especially have been increased in diameter one-third, or their section doubled in twenty years past, and there is room for further increase. It will be hard to assign any reason why the main bearing of the spindles of small lathes from 10 to 30 inches capacity should be less in diameter than one-fifth of the largest work they are to turn, and for larger lathes one-sixth to an eighth, as the size increases. Such dimensions have reference to face work which all common engine lathes are supposed to perform, the spindle becoming a lever for which the main bearing is the fulcrum.

THRUST BEARINGS.

An English machine-tool maker once said to me, "You Americans have a practice of taking up thrust on collars; we do not dare to do such a thing, but always put a hardened steel screw against the ends of the spindles." This man was a maker especially of implements for marine engine shops, and had "under his nose," so to speak, seen the development of thrust bearings for propeller shafts without even thinking of the analogy between these and the spindles in his machine tools. As there are many machine-tool makers in this country, as well as in England, who will modify designs, generally for the worse, in order to introduce end thrust screws, some remarks on these will be in place.

For a century at least it was believed that to resist thrust on a shaft or spindle an "abutment" at the end was necessary. The wear of such bearings and frequently their destruction by "seizing," called in hardened material and tempered steel points and steps became the rule. The wear of such thrust bearings into a conoidal shape offered no suggestion until the philosophy of the matter was worked out by Mr. Schiele, of Manchester, England, who became a kind of a "crank" on the subject, and applied to various purposes the curve of "equal tangents," or "Schiele's curve," it was called, for resisting end pressure.

Mr. W. B. Bement, founder of the Industrial Works, now Bement, Miles & Co., of Philadelphia, with his keen perception of mechanical problems saw the advantages of the Schiele system, and introduced it to some extent in his works, especially to support heavy running tables.

The Schiele curve shown in Fig. 58 means simply a bearing wherein compensation is in proportion to velocity and wear, and is the form that all end thrust bearings assume, or tend to assume by wear and abrasion. The figures on the horizontal ordinates represent velocity, 90 being the maximum, and the tangents at *a* on the other side represent the degree of compensation by end adjustment.

When marine propellers came into use

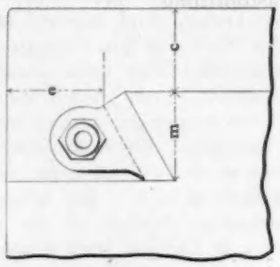


Fig. 65

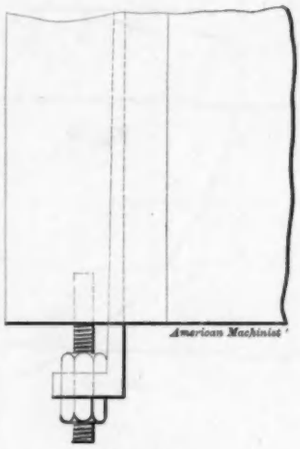


Fig. 66

the first attempt to resist the thrust on the shafts was by means of the traditional flat end bearing, which soon failed, and after many experiments the solution was found in a series of shallow collars forming a bearing with surfaces moving at a speed approximately uniform. This problem has nearly disappeared from marine engineering, and in going over a miscellaneous collection of prints of machine tools one will find it is disappearing in them also. Messrs. William Sellers & Co. discarded the end thrust screw for lathe spindles more than twenty years ago, and it has nearly disappeared from drilling machine spindles. One of the earliest applications of the collar thrust bearings in this country was to support the heavy Fourneyron turbine wheels at Lowell, Mass., about forty-five years ago, no doubt in use to this time.

For pressures not too great, or not maintained continuously, end bearings are convenient and complete, but there are many facts that go to show the failure of bearings with radial faces. Rotary engines are one example. These necessarily involve radial faces that must be kept steam tight, and in the nature of their operation must fail.

Propeller shafts that sometimes sustain a thrust equal to 10,000 horse-power furnish a complete example for thrust bearings, that is, shallow collars, sufficient in number and area to reduce the pressure within reasonable limits. It is not contended that the thrust on machine-tool spindles should in all cases be taken up by collars, but that there is no need of modifying designs to admit of end bearings, as is done by many makers in England.

SLIDING BEARINGS.

All flat or sliding bearings have to be reciprocating, and have usually but slight pressure in proportion to area when compared with rotary bearings. This is fortunate; otherwise their maintenance would be a serious matter. There is some reason, not very well understood, that causes rapid wear of reciprocating or oscillating bearings under circumstances where a rotary one would endure. Oscillating bearings under pressure are seldom required in machine tools, but are sometimes employed in levers to modify range or stroke, and in links for slotting and shaping machines. In such cases it is common to provide for wear at the rotary or crank-pin end and let the oscillating end take care of itself, under the assumption that the wear will be in proportion to movement. This is not the case, however, and a careful designer will provide ample surface and good material for all oscillating bearings that sustain considerable pressure.

It may be noted that such bearings seem to require a different material from those with rotary motion. For example, bushes or boxes of phosphor bronze give the best result for oscillatory motion, and other alloys for rotary motion. There are some obscure conditions attending on the performance of oscillating bearings, arising, no doubt, out of the molecular structure of metals that affects lubrication and wear.

As a rule metals of a granular structure are most suitable for slides or reciprocating bearings. Fortunately cast iron is one of the best and is suitable for both surfaces. It is alarming to think what an impediment would arise in machine-tool practice if cast iron surfaces in contact would perform no better than those of wrought iron, soft steel, brass, or other alloys. It is this fact that enables a cheap, simple and durable construction of the sliding bearings in machine tools, adapted in every way to the requirements, when

properly fitted. By proper fitting is not meant that the surfaces should be trial-fitted into complete contact and scraped up to a "motley" finish, but that they may be made straight and flat with a fair contact of half or more of the whole area. There is some advantage from a certain degree of roughness in sliding surfaces that permits efficient lubrication, especially at starting a new bearing.

Messrs. Tangye Brothers, of Birmingham, England, extensive makers of steam engines, who sometimes have three hundred in process at one time, formerly spent a good deal of time in scraping down the slide valves to a perfect fit. On one occasion when an engine had to be started before the valves were fitted by scraping, it was discovered that they were steam tight and could be moved with half the usual force. Acting on this hint they began planing the valves and seats carefully and leaving them at that. This has been found an improvement in every way and a safeguard against abrasion. It is true that surfaces held together by an elastic pressure, as in this case, have no parallel in machine-tool practice, except planing machine tables, and are easy to maintain in comparison with positive bearings, but a degree of roughness seems to produce a like effect in all cases.

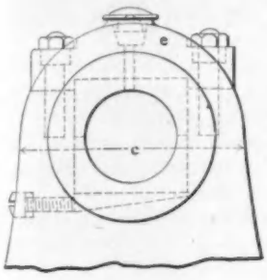


Fig. 67

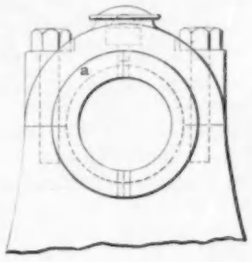


Fig. 68

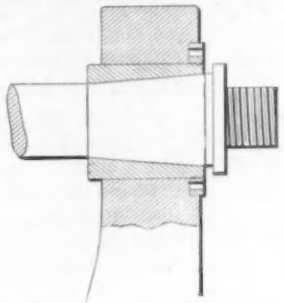


Fig. 69

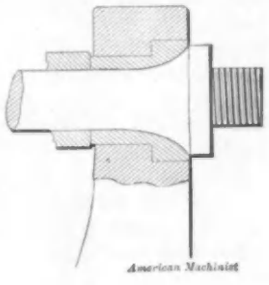


Fig. 70

SPINDLE BEARINGS.

GIB JOINTS.

There is in modern machine-tool practice an increasing tendency toward rectangular slides instead of the angular or oblique form, especially for long bearings subjected to heavy strain, and a corresponding gain in stability, and avoidance of friction. When guides are held in contact by gravity, as in the case of planing machine platens, there is no doubt that oblique faces are most suitable because self-compensating without gibs, but some makers in England have had very favorable results with flat bearings for planing machines, notably the Gresley Iron Works (Smith & Coventry), at Salford, England, who have always made their planing machines with broad flat ways and lateral gibs, firmly bolted down at one side, any lateral wear being taken up by packing; but such adjustment is seldom required.

The makers claim that in heavy side cutting there is no danger of moving the platens from their bearings, and that the friction is less; also that the bearing surfaces can be efficiently lubricated, which is not possible with angular or V-ways, because of the oil running off. This practice has continued for about twenty-five years. Fig. 59 shows the method, *a* being the compensating bar or gib.

There is no doubt that in modern practice natural selection has settled the type of gibbed joints in the best manner, but not the means of compensation when this is done with set screws bearing upon flexible strips inserted in the joints, as shown in Fig. 60. Objections to this system of gibs are the thin bars that bear only at certain points, the manner of fitting the set screws, and in planing out the corner, as at *a*, which does no good, weakens the slide and requires the gib bar to be beveled at the top. The form at *e* is easier to make and better. The set-screws are, however, most often at fault.

The writer, one time, in the plenitude of his wisdom, had the cutter slide of a wheel cutting machine fitted up in a careful manner, and to secure a good bearing of the gib joint for the cutter saddle, had that arranged as shown in Fig 61, following practice he had learned thirty years ago in one of the best machine-tool works in this country. The machine was put on some heavy work for a test, and the workman in charge reported that he could not keep the saddle down on its bearings. An examination showed that forcing in the screws *e* only made the matter worse, and further examination of the matter disclosed the fact that, as arranged, the screws forced the gib bar down into the corner at *c*, lifting the saddle, and had an effect just the opposite of what was intended; that is, lifted the saddle from its bearings at *c*.

Mechanical expedients often fail to perform their purpose, but seldom produce an opposite result, as in this case. New screws with beveled points, as shown in Fig. 62, were substituted, and no more difficulty occurred. Pressure was changed from the line *m* in Fig. 61 to the line *n*, as in Fig. 62. The gib bar and screws were afterwards discarded and a wedge substituted, which should have been done at first. There are places where these set-screw joints are necessary or best, but not many, and they are gradually disappearing.

Lathe cross slides are among the most difficult to arrange in a satisfactory manner. I have successfully employed the method shown in Figs. 63 and 64, which are substantially the same, either of them holding firmly, and with a guard apron at the back, behind the slide, are secure from chips; also permit more clearance over a carriage than with a raised ledge, as in Fig. 65. The joint at *e* is packed, set down solid, and seldom requires adjustment.

The wedge form of gibs, shown in Figs. 65 and 66, is one of the best, but is open to the objection that the projecting wedge is often an obstruction, and is always unsightly; also has a limit of length that is an impediment for long slides. The dimensions *e* and *c* are commonly too small and permit flexure of the saddle, not observable, perhaps, except in the action of tools. The slightest yielding destroys the fit or bearing over all the surfaces. Such yielding or flexure is not always due to working strains, but frequently to clamping tools, or work on saddles, and the safest way is to employ heavy sections.

The section of rupture is in Fig. 65, and in the case of outward strain it produces a wedging action of the oblique surfaces intensified as the angle, generally unprovided for to the required extent. The dimensions *e* should at least equal *m*, and the dimension *c*, when not reinforced by ribs or otherwise, should be still greater, a quarter more at least.

SPINDLE BEARINGS.

The adjustment or compensation of the journals of machine-tool spindles is one of the most difficult problems that makers have to deal with, and out of this has arisen the attempt to make journals that would not wear, those of hardened steel, for example. Wear demands compensation, and a journal adjusted from one side affects the alignment of a spindle in proportion to the wear that takes place, while any adjustment, not concentric, must destroy the fit of a journal in its bearing. The means adopted to meet these difficulties have been various, tentatively and experimentally derived, and so far as

known, the subject has not been adequately treated in books. The journals of steam engines, land and marine, have received by far the greatest amount of attention given to bearings, but, unfortunately, this experience affords but few suggestions to machine-tool makers, unless it be the quarter brasses of main journals, providing adjustment in two planes, which certainly is suitable for the spindles of large lathes, boring machines, and like implements. A capped bearing, closing as a semi-circle on one side of a spindle, is certainly an imperfect form for a bearing, unless it is assumed that no wear is to take place, and the extended use of such bearings is due to the convenience of fitting and the removal of spindles laterally, without stripping them; but the objections are serious, notably in lathes where the cap screws receive the principal cutting strains.

It is not desirable in any case to have the principal cutting strain fall upon a bolted-on member, or directly upon holding screws, even when they are fixed and not adjustable. It is not good practice, in theory at least, and is the reason, no doubt, why some of the principal makers provide solid bearings for their spindles, compensated by means of tapering journals, or not at all, as is common in some of the best made drilling and other machines of the present day.

There is not much objection to a bolted-on cap over the main bearing of a lathe, or other machine spindle, if adjustment is provided by other means and the cap is screwed down solid, as in Fig. 67, for example. Objections to this are possible, however, such as flexure of the cap *e*, and the necessary width of the head at *c*. If removable caps are employed with either solid or split shells, the construction shown in Fig. 68 is no doubt the preferable one, the shell *a* being arranged to be set in different positions, in case of wear at the top or bottom.

For spindles that have no end play and are mounted in framing that will not spring, the plain conical bearing shown in Fig. 69 is one of the best. It is rigid, has concentric adjustment, and is inexpensive. A common method of holding these bearings longitudinally is with a collar or collars screwed on the ends, which if sunk, as shown in the diagram, makes a neat flush job, and also supports the shell the whole length so it can be made thin and yet be firmly held.

If the taper is made as in Fig. 70, an approximation to the Schiele curve, the spindle hardened and the bush made of some hard alloy, it produces a durable and steady bearing, but is less convenient than when the taper is the other way.

Fig. 71, where the taper is reversed and made abrupt enough to withstand moderate forward thrust on the spindle, is a desirable construction for bearings to perform light work, as in amateurs, jewelers, or other light machines. The reduction in the diameter of the spindle at the front is objectionable for heavy work, unless the journal is made very large in diameter. The bushes are commonly made of steel and hardened, in which case they should be ground on the outside to correct distortion caused in tempering them and insure a fit in the seat.

Fig 72 shows a construction sometimes met with, that of a bearing bush fitting into a conical seat. Such bearings are no doubt made under the impression that they are adjustable or compensating, but it need not be said they are not, in any practical sense. The cone is not adjustable in the line of its axis and can fit at one point only. Such a contrivance may "grip" a shaft or spindle, especially if the bush is slit into a number of parts, but cannot in any case fit perfectly in its seat, which is almost as important as fitting around the journal.

There are various other forms of bearings employed, many of them good, but complicated or expensive; all of them, however, coming within the rule that adjustment must be normal to the bearing faces. In the last example it will be noticed the line of adjustment is parallel to the bearing or running faces.

As the surface or area of bearings is increased and the means for fitting and the materials are improved, we may look for a more extended use of solid or non-compensating bearings for machine tools. There are many facts that go to prove that stiff spindles, mounted in rigid bearings of cast iron and carefully fitted, do not require compensation, and there is no doubt that prejudice or mistrust prevents the use of iron bearings in many cases where they are best. In the United States Armory at Springfield, Mass., most of the machine spindles of the profile and other machines were mounted in cast iron bearings, and those that were not at first had in some cases to be changed.

The old firm of Wood, Light & Co., at Worcester, Mass., always employed cast iron for bearings in their lathes and other tools, and contended it gave the best results. Such bearings should in all cases be scraped to a fit and provided with ample and reliable means of lubrication to prevent danger of seizing, especially when the journals are of soft steel. If the journals are hardened and properly mounted in bearings of cast iron the chances are that the oil will run off clear, showing that no wear takes place, and years of use will not produce appreciable change.

I once mounted a small spindle in solid cast iron bearings, cast integrally with a mass of iron to conduct away heat, and found no wear after five years of use, although the spindle was driven at 7,000 revolutions per minute. Other spindles for like purposes, having bearings of the usual alloys, required compensation at short intervals, and always fouled the oil, indicating continual wear.

It is not easy to determine what the real properties of cast iron may be for spindle bearings. There is a prejudice against its use, and for good reasons unless the fitting is done with care. For flat or sliding bearings, which are more carefully fitted than cylindrical ones, everyone knows its value, and the probability is that the difference is mainly in the fitting, though probably the more liberal allowance of surface usually found in flat bearings has an important influence.

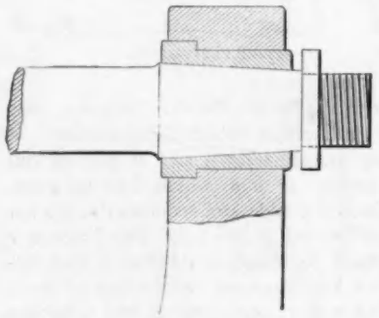


Fig. 71

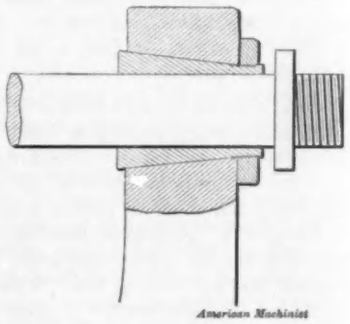


Fig. 72

SPINDLE BEARINGS.

French Regulation of Automobiles.

France has recently adopted some revised regulations with regard to the operation of automobiles in that country. These regulations provide that automoblies must be so constructed as not to allow any matter to escape which might cause explosions or unpleasant smells. They must be built so as not to frighten horses, so that nothing will obstruct the view of the driver, so that they may be lit up after dark, and the handles regulating the machinery must be so arranged that the driver can work them without taking his eyes off the route he is following. Every vehicle must be provided with two distinct systems of brake, each capable of shutting off automatically the force of the motor and bringing it under instant control. One at least of these systems must act directly on the wheels or axles in such a manner as to bring them immediately to

a standstill. All carriages exceeding 250 pounds in weight must be able to reverse their machinery and run backwards. Foreign vehicles must be passed by the French authorities before they are allowed to run in France.

A Large Double Radial Drilling Machine.

The accompanying half-tone represents a special radial drilling machine which is notable for its great size and power—of which, by the way, the illustration does not give an adequate idea.

The machine was built by the Newton Machine Tool Works, of Philadelphia, for John Brown & Co., of Sheffield, England, and is intended exclusively for drilling and tapping armor plate. It is hence extremely massive, while at the same time neither universality nor great hight under the arm is required.

Most of the features of the machine are apparent from the illustration. The Newton practice of a steep pitch worm for driving the spindle will be seen to be followed. Reversing clutches for tapping and worm gears for turning the arms will also be seen. The steps for the arm sleeves are ball bearings.

The following list of leading dimensions will indicate the massive character of this powerful tool:

Diameter of spindles—5 inches.

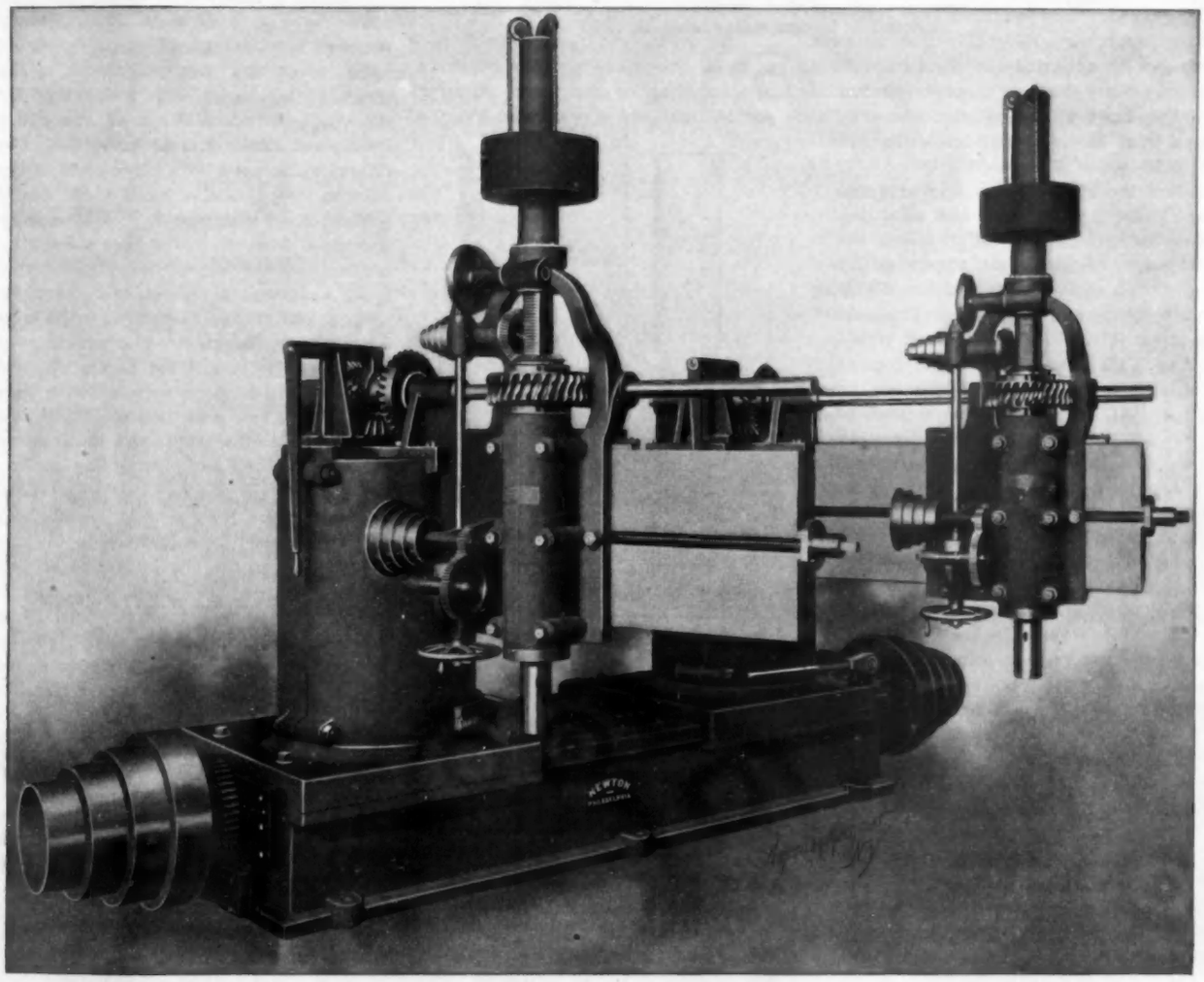
Reach of arms—6½ feet from center of columns.

Depth of arms—30 inches.

Outside diameter of sleeve surrounding column—3 feet.

Length of bed—12 feet.

Net weight—45,000 pounds.



SPECIAL ARMOR PLATE DRILLING MACHINE.

The Machine Paid Its Way.

It seems that others besides Corliss have overcome the prejudice against new machinery by offering to take pay out of savings effected by it. The "Farm Implement News" prints the following:

"Did I ever tell you," asked the veteran implement man, "how I obtained $150 for a $75 wheat drill? It was down in Hamilton County, Ind., about fifteen miles north of Indianapolis. I was running a store in the Hoosier capital at the time, which was more than thirty years ago, and used to do a great deal of canvassing. Wheat drills were not used very extensively in those days, most of the wheat being sown broadcast. I determined to make a special effort on drills one fall, and to that end rigged up a wagon on which I could carry three complete machines. For two days I was unable to find a farmer who took the least interest in what I had to say; but on the third day I so elaborated my talk and claims of what drilling would accomplish as compared with sowing broadcast that a farmer challenged me to a test. I had boasted that a drill, while saving half a bushel of seed to the acre, would produce more wheat than the old method, enough to more than pay the price of a drill in one season. The old fellow proposed that I return the next week with a drill and put in forty acres, while he sowed forty by the old method, the two patches to be side by side. If the drilled wheat yielded more than the other I was to have the excess as the price for my drill. I was a trifle dubious as to the outcome, but accepted the proposition. I unloaded one of the drills and promised to return in a week. The machine was one of the old Moore drills, made at Dublin, Ind., a good one in

its time, but nothing to compare with the drills of to-day.

"The next day I spent three days with the farmer and put in forty acres of wheat, two and a half bushels to the acre, while he sowed three bushels to the acre. A committee of neighboring farmers watched the proceedings and consented to act as judges when the crop was harvested and threshed.

"About the first of June following the farmer came into my office and after discussing various topics finally blurted out the object of his visit. He wanted to pay for the drill and have the matter off his hands. 'But,' said I, 'you don't know how much it will be.' 'That's all right,' said he. 'I'll just pay you the regular price with interest from January 1, and let it go at that.' I saw that he wanted to get out of a bad bargain and determined to hold him to the agreement, partly for the money in it and partly to see what the difference would be, so I refused. A week later he came again and offered me $85 to cancel the contract, but I still refused. The next time he proposed to pay me $100 to get released, but I remained firm. Finally he said he would give me $150, which was double the regular price, and as he appeared to be getting pretty sore over my repeated refusals, I concluded that it would be policy to accept his last offer. But I made him give me his word of honor that he would tell me how much more he realized from the drilled wheat, a promise he readily gave. After the harvest he told me that he had received over $200 more for the drilled wheat than for the other. That year I sold eighteen drills in that one township. It was one of the best advertisements I ever had. The farmer furnished it and paid for it, too."

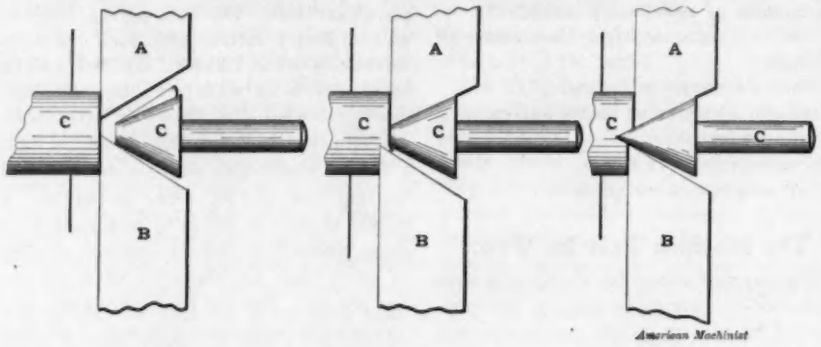


Fig. 1 Fig. 2 Fig. 3

MAKING A NEEDLE VALVE.

Making Needle Valves—A Bevel Cutter for Internal Work—A Special Chuck—Rack Cutting—A Turret Lathe Tool.

BY A. H. CLEAVES.

Figs. 1, 2 and 3 illustrate a method I once used for getting around a bothersome screw lathe job. The work *C* was a lot of needles for bicycle valves, and the aim was to finish them with good points and free from burrs on the side of the taper left by the tool as the work broke off at the end. To do this I used two tools, front and back, as seen at *B* and *A*, the shank having been made with the turret tools, the whole process requiring but one handling of the work. Getting the points right for appearance, and the taper smooth where it fitted the valve, being the main thing, that will be described.

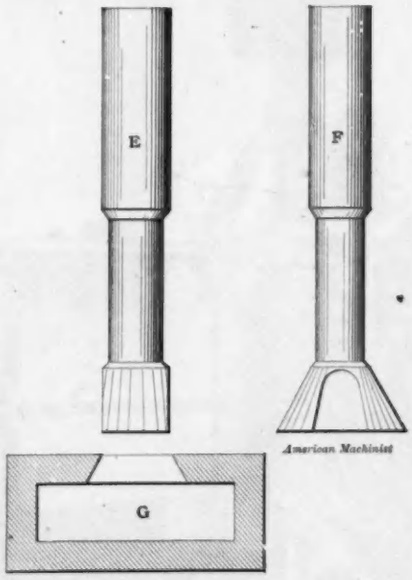


Fig. 4

INTERNAL BEVEL MILLING.

In Fig. 1 the work is shown as it would break off with one tool; and then the front tool *B* is seen at a more obtuse angle than the work as it cuts off and points the work on the last cut.

In Fig. 2 the back cutter *A* is shown making the first cut in front of the point, as the chuck stands. Then the cutter *B* comes down pretty close, and *A* is brought in again to take off the face burr on the work, and then *B* is run in as at Fig. 3 to finish the cut; the angle shortening the point from what the cutter *A* would make if extended, as shown by the dotted lines, Fig. 3.

Fig. 4 shows front and side view of a bevel cutter used for milling work similar to that shown at *G*, or the under side of a slot that cannot be approached with a mill from that side. The cutter is slabbed off to drop down into the slot when the bevel is cut to the required distance.

I found a bench-lathe chuck like that shown in Fig. 5 to work admirably for turning and facing off some insulated brass rings for electrical work. The chuck *H* was solid with a shoulder for the rings *J*, which were of exact size inside, and made in large quantities. The tightening screw *I* with taper point forces out the two pins *K K* against the ring *J* to hold it. These pins *K K* are made by driving a solid pin in the hole where they belong, and boring or reaming out the taper and turning off the ends, then removing and cutting them in two and freeing them in the hole. The shoulder on *H* locates the ring *J* for facing off, and the work can be done with a double slide rest, a slide rest with two tool posts side by side, or with a single tool made to cut over the rim of *J* and also on the face.

Fig. 6 is a cut of a tool that I find indispensable with a three or four-jawed chuck for small work; *L* being a rod to slip into the opening in the chuck, and to be held by the set screw. For small work, such as short pieces to be cut off or faced off to one length, the rod *L* alone is all right; or for holding thin disks or thick ones, and placing them quickly with a true face like *M*, a number of different diameter pieces to fit the taper, as shown, say two, will be found decidedly agreeable. *N* shows one of the chuck jaws on *M*.

Fig. 7 gives an idea of a good method for cutting small racks in a milling machine where they come within the capacity

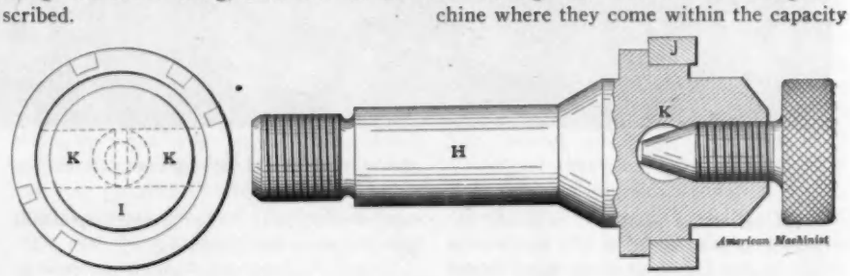


Fig. 5

A SPECIAL CHUCK.

of the regular arbor and the cross-cut of the machine. Any number of cutters, say five, separated by collars of equal length

are used, and the work moved one space of cutters to cover the teeth cut by all. Thus if there were ten teeth between two cutters, ten moves on the index handle would cover fifty teeth. In moving the work, set the index ring or finger at *O* each time, and take up the back lash, if there is any, the same way each time, too.

R shows one kind of holder, where the

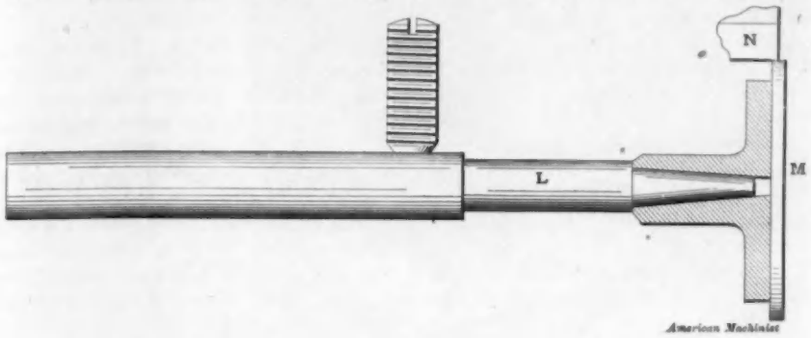


Fig. 6

A CHUCKING DEVICE.

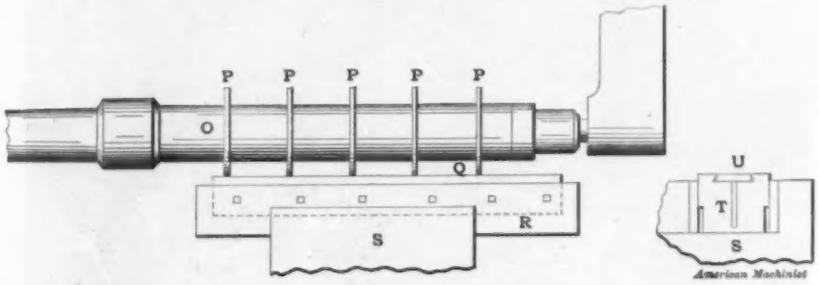


Fig. 7

MILLING SMALL RACK TEETH.

teeth are cut on the edge of stock; and *T*, Fig. 8, another for teeth cut on the flat side, *Q* and *U* being the work.

Figs. 9 and 10 display a tool for bicycle work used at the Peoria Rubber Factory and elsewhere. This is for cutting a ball-retaining groove in a cup, as seen in Fig. 9. *V* is the tool-stock held in the turret, *W* a slide moving crossways in the same and carrying the tool *Z* held by the screw *X*. The post *Y* carries a single-tooth pinion running in the single rack-tooth space in *W*, and is worked by the handle *c*; *a* is the cup, and *b* the groove.

Peoria, Ill.

A Peculiar Boiler Accident—Result of a Vacuum.

The "Shipping Gazette" (British) gives us an account of a most peculiar accident in connection with a steam boiler. This case is authenticated by the British Board of Trade.

The British steamer "Elderslie," of 2,761 tons gross, was at Smyrna last October. The boilers having been blown down, the third engineer, E. Marshall, proceeded to open up, assisted by a Greek fireman. The boilers were two in number, double-ended, and apparently of the ordinary return-tube type. The manhole door which was being removed at the time of the accident was 16¼ by 12¼ inches, and was in the end plate at the after end of the boiler. According to the testimony of the Greek fireman, Spinoli, one dog or crossbar had been taken off the door and the other nut started, when Marshall sent him to prepare to take off the door of the manhole of the other boiler. The fireman had only just left when he heard a loud report, and going back could see nothing of the third engineer or of the door, the manhole, of course, being open. The chief engineer, who was on deck at the time, then joined in the search for Marshall. He says the boiler was so hot that he could not keep his hand in it, and on trying to put his head through the manhole, found it impossible to do so on account of the heat. He at first thought that the third engineer had allowed the door to drop into the boiler, and in attempting to get it out had gone inside and had been overcome by the heat. He then tried to look in with lamps, but could see nothing until he got the forward bottom doors off, when he discovered blood on the sides of the furnace.

The boiler was then allowed to cool down for about four hours, after which it was possible to get inside. The dead body of the third engineer was then found lying on two of the longitudinal stays close to the forward end plate and opposite the manhole. The skull was fractured, and there were evidences of scalding. It would thus appear that the man was drawn into the boiler and carried from end to end, a distance of 16 feet, and was thrown against the opposite end plates with sufficient force to fracture his skull. Moreover, the arms and shoulders looked as if they were seriously injured, and the clothing was torn in places. The body was discovered on a level with the place where it was drawn in, evidently having slid along the longitudinal stays. The manhole door was found resting on the tubes at the same end, and almost immediately below the body, it also having been carried nearly the length of the boiler, but, being small enough, it fell between the stays.

The only explanation of this remarkable accident appears to be the one given by the Board of Trade circular. When the boilers were blown down neither the safety valves nor cocks were opened, although the chief engineer gave instructions that they should be. The boiler was evidently blown down at a fairly high pressure, and when the steam condensed there would be a loss of pressure inside, so that the tension there would be considerably less than the atmospheric pressure outside. Marshall was working on a platform level with the door. When the latter was removed the rush of air carried him in, dashing him to the other end of the boiler in the manner described. It is supposed that the deceased was almost in a lying position as he worked, and, it is conjectured, was holding the door by one of the studs, or by a piece of rope which was attached to them. Probably when the door was loosened it would be driven inwards suddenly by the atmospheric pressure, and the man trying to hold it back would be drawn into the opening, which his body would nearly fill.

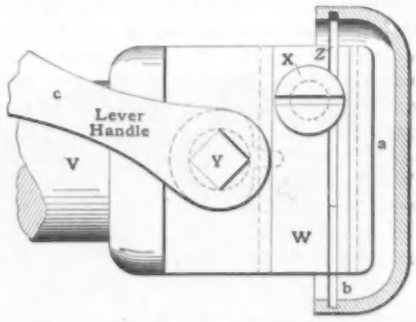


Fig. 9

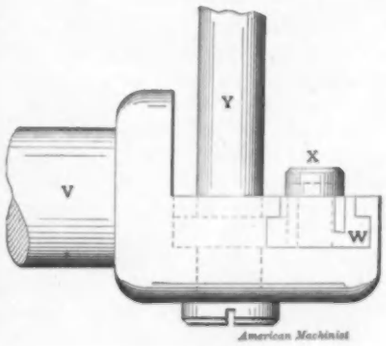


Fig. 10

A RECESSING TURRET TOOL.

In such a case, which is extremely probable, it is easy to understand the great force with which he would be projected

to the opposite end of the boiler. He is said to have been a small man, 5 feet 5 inches high, and weighing 10 stone. The weight of the door was 85 pounds. The area of the manhole was 156 square inches, and it is assumed that with a temperature of about 180 degrees in the boiler there might exist an external pressure of 7 pounds to the square inch, which, if suddenly applied, would exert a force of 1,092 pounds. The formation of a partial vacuum inside a boiler is not an uncommon occurrence, and it is a precaution always taken by a careful engineer upon blowing down his boilers to open the gage cocks in order to prevent the formation of a vacuum. Otherwise the boiler may fill itself again from the sea if the blow-off cock be left open, and in this way most undesirable strains may be set up owing to unequal contraction through sudden cooling.

A well-authenticated instance is quoted of a very similar nature. In this case the junior engineer pumped the water out of the boiler without admitting air. Assisted by a Chinese fireman, he proceeded to take off the lower manhole door, which was a few inches above the stokehold floor. The Chinaman squatted down, after the manner of his race, and was left to remove the nuts and dogs. When he started the door he was instantly drawn in towards the boiler, his stomach closing the aperture, the door meanwhile being projected to the back end of the boiler with a loud report. The unfortunate fireman was thus held captive until the engineer, attracted by his cries, opened the gage cocks and thus destroyed the vacuum. The man suffered great pain at the time, and complained of internal injuries, but as he was at work again in a few days, it was concluded that they were not of a permanent nature.

New Vehicles at the Electrical Exhibition—I.

The Electrical Exhibition, Madison Square Garden, New York, May 8 to June 3, shows in the most unmistakable manner the great advance made in electric vehicle construction during the past year. Something like thirty separate vehicles are shown, by five different makers, and these new storage battery wagons not only exhibit a great variety of vehicles in different and pleasing forms, but justify the important conclusion that at least four of these five makers have evolved what they regard as satisfactory types of two and four-passenger wagons, thus bringing their product into perfectly defined standard forms. Standard forms of manufacture must of necessity precede economical construction.

No previous exhibition of motocycles has shown strongly individualized and clearly defined types of construction. Hitherto, where a maker has shown two or more vehicles, they have been of divergent construction, thus showing tentative efforts towards the creation of a satisfactory wagon, without giving any convincing proof of successful attainment of the thing sought.

The recent display changed all this, and the Waverly, the Columbia, the American, the Fischer Equipment Company and the Riker establishments each showed a considerable number of wagons adapted to meet different conditions of traffic, and exhibit a constant repetition of details in the product of each maker which is highly satisfactory, as showing that these makers have found what they regard as thoroughly practicable devices, meeting all the requirements of horseless traction, so far as the carrying of two or four passengers is concerned.

The American Electric Vehicle Company shows only three wagons, two runabouts, to carry two passengers, and a delivery wagon with glass sides, all of pleasing outline and substantial construction. Delivery wagons are also shown by each of the other four exhibitors. The Columbia shows the widest variations in forms of vehicles, and the highest prices, while the Waverly and the Fischer Equipment wagons are offered at the lowest figures; Riker standing between the two in the matter of cost. Some idea of the great variety of form shown in these twenty wagons may be gained from the fact that it was needful to take nearly seventy-five separate photographs to even fairly cover the noteworthy details shown.

The Waverly exhibit of one delivery wagon, one Stanhope and four wagons of the "runabout" type, was first in complete form for description, and consequently will be first shown here. These vehicles are the product of the Indiana Bicycle Company, Indianapolis, Ind., which has a present capacity of ten wagons per day, and makes the entire vehicle, including the storage batteries and the electric motors. The tires used by this establishment are made by the Western Rubber Company, also of Indianapolis, and understood to be in close relations with the Indiana Bicycle Company.

The general scheme of the Waverly running gear is to provide a single substantial trussed frame, constituting the rear axle support, the motor support and the reach, and to pivot to the front end of the reach another substantially trussed piece which carries the front wheels, the pivot being so placed as to permit the front wheels to move freely in a vertical plane. This construction has many advantages. It gives a good support to the motor and the transmission gear, and ensures a perfect adjustment of all four wheels to the road surface. The front wheel support takes the form of a low triangle, and is made very stiff fore and aft by doubling its members, all as pretty well shown in Figs. 1 and 2, which are detail views of the front wheel support and that part of the steering gear which is placed below the body of the vehicle. Except the delivery wagon, all of the Waverly vehicles have exactly the same running gear, the only difference being in the wheel base, which can be varied very readily by simply changing the length of the reach members. Fig. 2 shows the construction of the front axle support the more plainly, as it is oblique, and hence exhibits the doubling of the top and bottom members of the pivoted triangular truss, which is, as will be seen, quite free to vibrate in a vertical

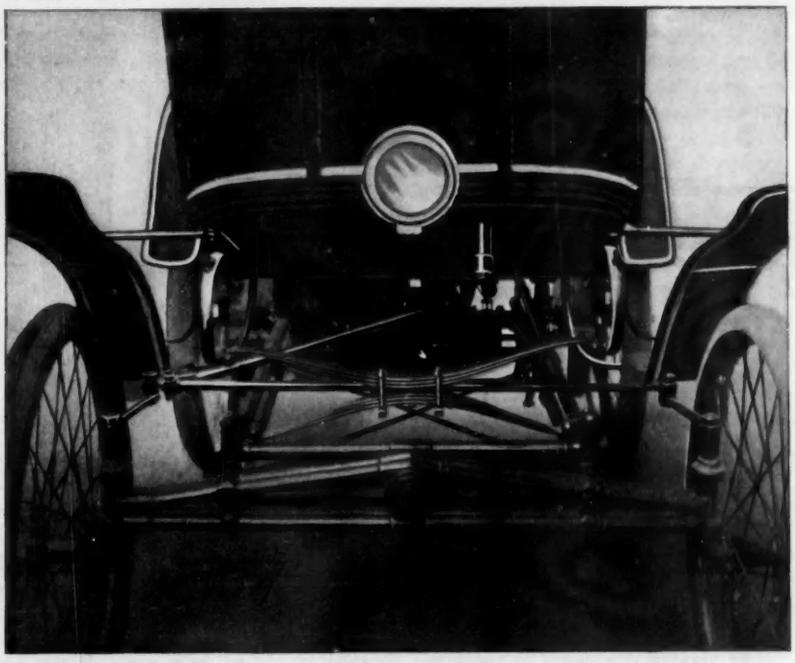


FIG. 1. FRONT VIEW OF WAVERLY FRONT AXLE CONSTRUCTION.

plane. The front spring is a reversed elliptic, with link suspension.

The front axle truss referred to is constructed of steel tube, with either dropped, forged or steel casting fittings, no malleable iron casting being used in any part of the vehicle. The Waverly designers believe that steel castings are fully equal for this purpose to drop forgings, and the castings can be made hollow when so desired, which is a very great advantage for some of the pieces required. This front axle truss finds its vertical support in the large horizontal pivot located at its mid-point, and is given an ample resistance to fore and aft movement by bearings against flat vertical surfaces formed at the front ends of the double-tube frame, which forms the reach and the rear axle support. The top ends of these reach fittings are formed with lugs to which the links carrying the lower members of the front springs are pivoted.

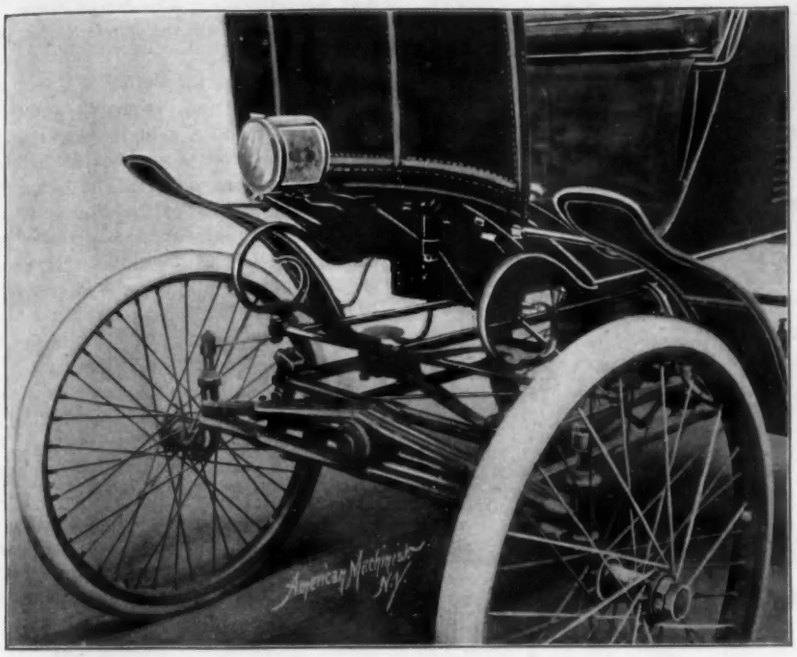


FIG. 2. WAVERLY FRONT AXLE SUPPORT, OBLIQUE VIEW.

The axle supports are, as clearly shown in Figs. 1 and 2, formed in the end fittings of the triangular pivoted truss. The axles themselves are of the well-known "L" variety, having a horizontal member which forms the axle proper, and a vertical member, carried on ball bearings in the vertical sleeve found in the end fitting of the truss. This sleeve is prolonged upward sufficiently to give a stable support for the axle, and the vertical member of the axle is carried up above the fitting to take the steering arms. The steering arms are connected by a parallel rod, pivoted to both of the arms, and the inclined upwardly reaching steering lever rod is connected to this parallel rod by a globe joint at the right-hand end—the terms "right" and "left" being always understood to mean the right and left as shown when the spectator stands at the rear of the vehicle, looking forward.

As the steering connecting rod is globe-jointed at both ends, the steering lever stand inside the carriage body (see Fig. 3) can be fixed to the carriage floor, thus giving the steering lever a fixed vertical position with regard to the driver's seat.

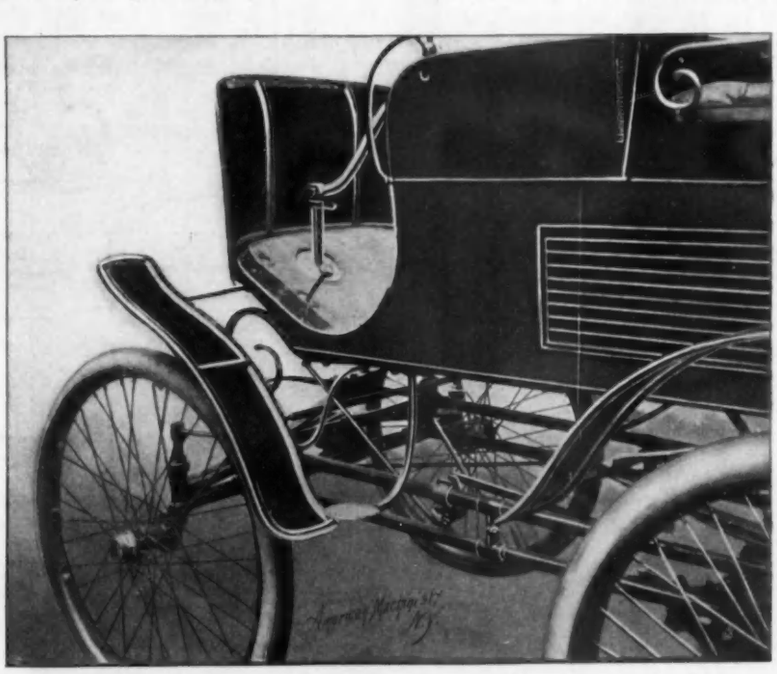


FIG. 3. WAVERLY STEERING LEVER SUPPORT AND CONNECTION TO FRONT AXLE.

Fig. 3 also shows the double tube construction of the reach, which seems to me to be at once strong and light, and to give every promise of excellent service. The Waverly running gear was criticised in my hearing by some makers whose experience gives weight to their words, as being needlessly elaborate—"complicated" was the word used—but in my own opinion it is one of the very best frames so far shown, and evinces a very full appreciation on the part of the designer of the work a carriage frame has to do, and a very skillful adaptation of means to ends to meet the requirements of this work. As previously mentioned, this frame is "standard"—that is, it is applied to all of the Waverly passenger vehicles without exception.

HUGH DOLNAR.

Mr. Tangye on Trusts.

Sir Richard Tangye, of Birmingham, England, speaking of our American trusts and American competition with British manufacturers, said recently:

"Trusts are vile things. I hate trusts from every point of view. America will one day awaken to the stern reality of the evil. Once the vileness of the evil has been fully realized, public opinion will be roused and some strong legislation must follow. As a strong admirer of the British workman, the British manufacturer, and the British business man, I think it is a pity that they are so slow to feel the shoe pinching. John Bull, speaking generally, looks at the silver medal too long, and forgets that his rival is after a gold one. He is content to dwell upon the gains of the past when he should be pressing forward. There are signs, however, that he is awakening, and these American trusts are just what have shaken him up. As for Englishmen losing so many orders to their American competitors, the explanation is that a pint measure can only hold

a pint. Every British manufacturer of standing is full to the bung with orders. If British manufacturers undertake more orders they would get them without doubt, but they are conservative, and do not believing in enlarging their houses until they are perfectly sure that the demand is not merely temporary."

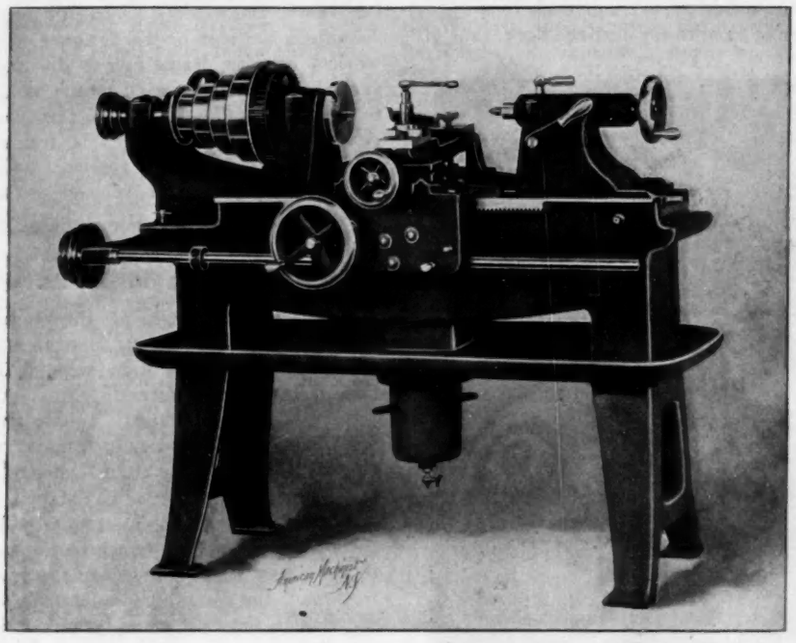


FIG. 1. SPECIAL LATHE FOR TURNING TAPER DRILL-BLANKS.

Lathe for Turning Drill Blanks.

As our readers know, blanks for twist drills are turned slightly taper to give them the desired clearance, and for this purpose special lathes are usually employed, these being of various designs, depending upon the ideas of tool builders or drill manufacturers who design them. We illustrate herewith the latest lathe built for this purpose.

Some time ago the Standard Tool Company, of Cleveland, requiring additional lathes for turning drill blanks, received propositions from a number of builders, and among them one from the Grant Machine Tool Works, of the same city.

This last proposition was finally accepted, and our photograph and drawings show one of a lot of thirteen lathes, which is now in use in the shops of the builder, the other twelve being at work in the factory of the Standard Tool Company.

While the lathe conforms in its general features to the familiar machine of its class, reference to the cross section, Fig. 3, shows a peculiar form of bed adopted to fit it especially for the work it is to do. It seemed desirable for this purpose to have a weighted lathe. It is desirable also at all times to maintain the alignment of the centers. At the same time the adjust-

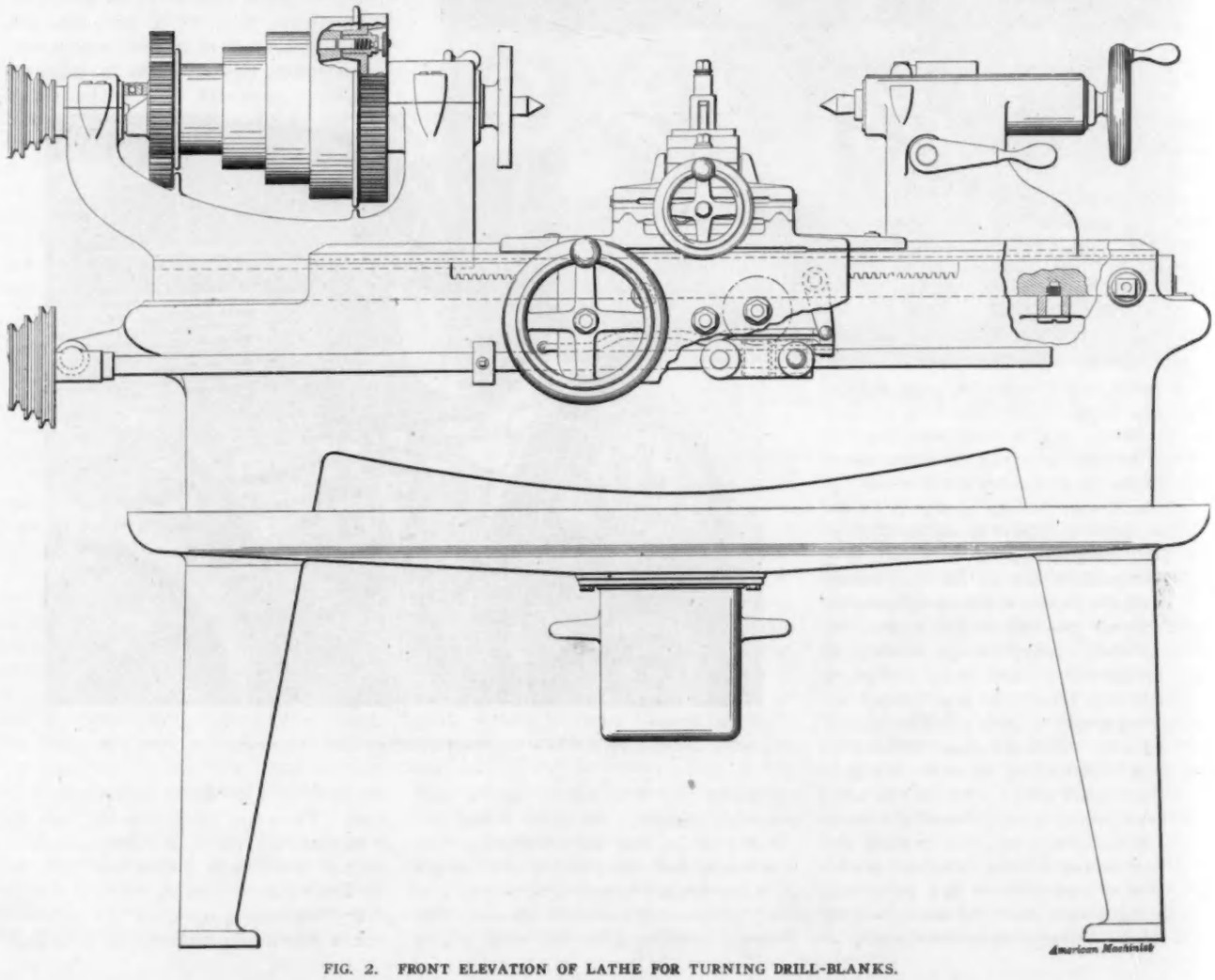


FIG. 2. FRONT ELEVATION OF LATHE FOR TURNING DRILL-BLANKS.

ment for taper-turning must be readily made, and be capable of considerable accuracy of adjustment. To this end the bed is made of the form shown, with a flat surface between the outer ways on which the carriage moves; this flat surface having fitted to it a swinging plate, while the foot-stock is clamped by an eccentric fastening in the usual manner; this eccentric fastening being attached to a yoke carrying studs at either end engaging with the T-slot, as shown in Fig. 3. In this view two screws are shown passing through the bed of the lathe upward into the swinging plate. The longer right-hand one of these screws is the one upon which the swinging plate swivels. The other is fitted to a slot in the bed, and there are a number of other similar screws at various points which are carefully scraped to a bearing under the heads and tightened up to a shoulder, so that it is unnecessary to loosen or tighten screws in adjusting the swinging plate; this being done by means of opposing screws near the foot of the lathe, one of which is seen in front. Both these screws abut against the swinging plate and hold it rigidly in any desired position, a pointer which swings over a graduated scale on the bed showing the taper to which the lathe is set.

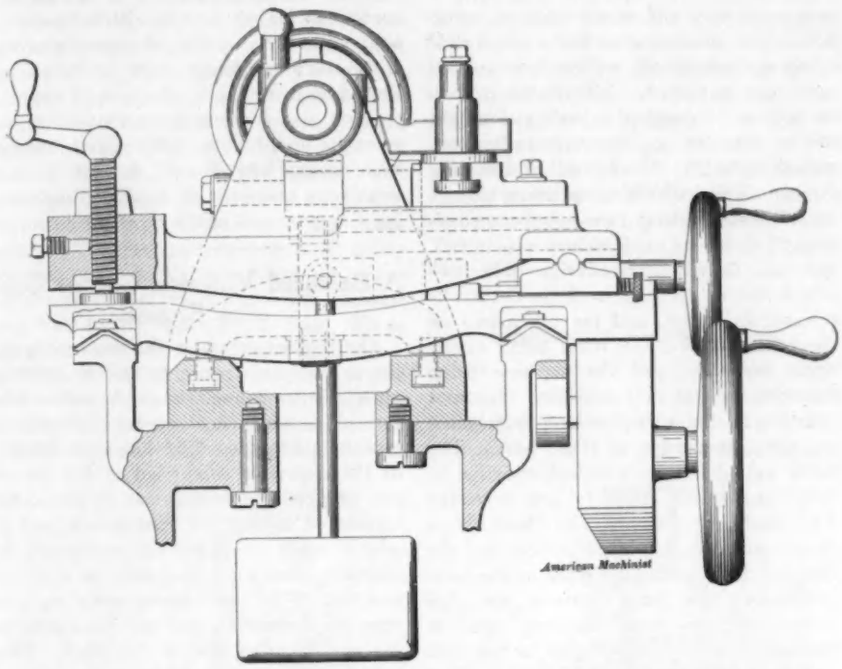


FIG. 3. PARTIAL CROSS-SECTION OF LATHE FOR TURNING DRILL-BLANKS.

Arranged in this way it is practicable to have an opening through both bed and swinging plate and to clamp the footstock without passing the clamping bolt down to the bed; which would make it necessary to loosen the foot-stock whenever any change was to be made in the adjustment of the plate.

For the purpose for which this lathe is used it was thought best to provide a drop feed and have it automatically disengage. This is done by means of the familiar disengaging device by which the worm is at any predetermined point dropped out of engagement with the worm wheel by the means shown in Fig. 2, and the point at which the feed is tripped is determined by setting the collar seen at the left of the carriage apron, Fig. 2.

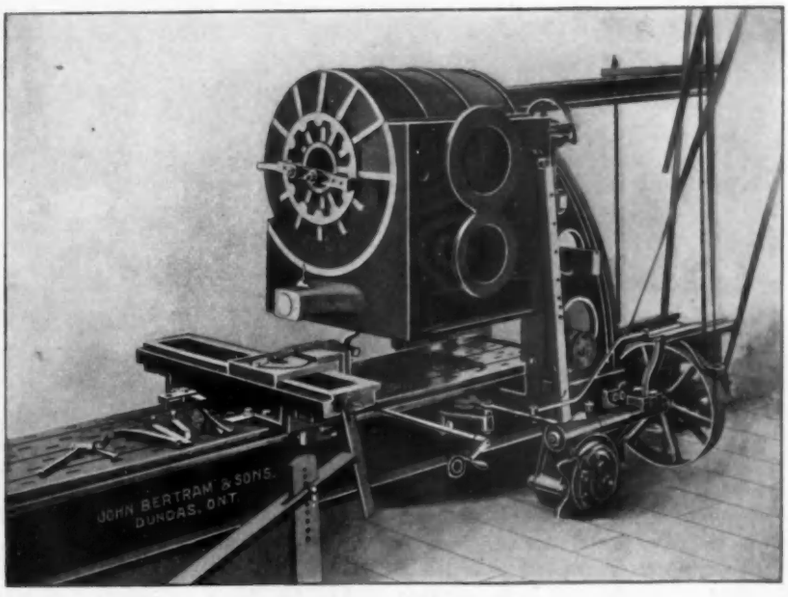
It is noticeable that very liberal proportions have been adopted in designing this machine, and the extent to which finished and polished surfaces have been eliminated and beauty of design secured without unnecessary finish, is exceptional, and the result, we think, decidedly pleasing.

It may be of interest to know that the interval of time between the ordering of these lathes and their actual completion was fifty working days, no drawing having been made previous to that time; and Mr. Grant informs us that on the completion of this lot of lathes only eleven hours of pattern maker's time was spent in making changes thought to be desirable in the patterns. Since the first lot was built we understand that the Cleveland Machine Screw Company has ordered some lathes like them.

Mr. Grant says, in regard to the lathe, that the ground has been previously pretty well threshed over, and he does not pretend that there is much new in this machine. He has simply endeavored to give it a new and pleasing dress. In this we think he has succeeded; while in the matter of new features there are at least as many of them as are often found embodied in one design. Though designed especially for drill blanks, it is of course evident that the lathe is adapted to other work as well.

Unique Planer Job.

The accompanying half-tone is from a photograph sent us by Mr. E. J. Armstrong, of the Ames Iron Works, Oswego, N. Y. It represents a planer job in process of execution at the works of the Robb Engineering Company, of Amerst, Nova Scotia—a shop in which Mr. Armstrong takes a paternal interest from his former connection with it, during which he designed and introduced the manufacture of the well-known Robb-Armstrong high-speed engine.



A JOB "THAT COULD NOT BE DONE ON THE PLANER."

The photograph is almost self-explana-

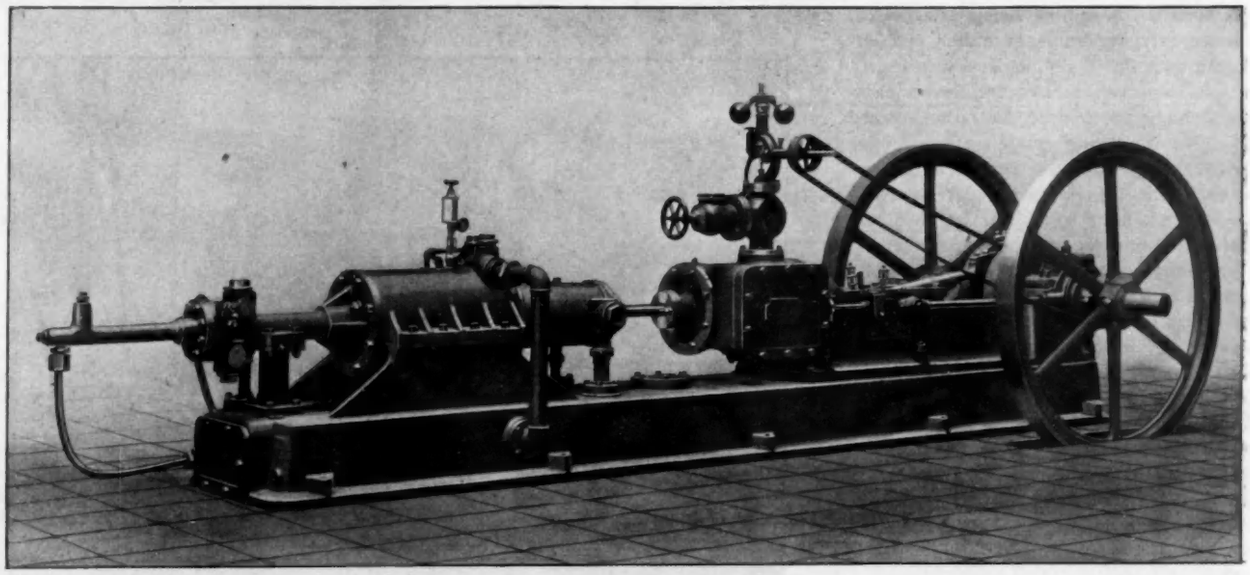
tory, and shows how a piece of work which was too large for the planer, and which might well have "stumped" any planer hand, was successfully completed. Not the least ingenious feature of the rig is the adjustable automatic feed, which consists of an arm attached to the feed gear on the feed screw, and placed so as to strike against the end of the inclined plank as shown, and be thus made to swing through an arc the length of which is determined by the hight to which the end of the plank is raised by the bolts that hold it.

The picture is not entirely clear as to this point, but we judge that the shaft extending out at the side of the planer carries the down-feed crank-handle, and at the other end is geared to the down-feed screw, which may be said to be transformed into an up-feed screw for this occasion.

The planer will be seen to be the product of a house of which probably most American mechanics have never heard, but which is a household word among mechanics in Canada. The Messrs. Bertram are probably the largest machine-tool builders in Canada.

A Four Stage High Pressure Air Compressor.

In considering the interesting air compressor shown in the half-tone it is proper to keep in view the conditions which it was designed to satisfy. The machine was designed and built for parties in Chicago who are experimenting with automobile carriages to be driven by compressed air, if, indeed, they have not advanced beyond the experimental stage, as this compressor is to be taken from city to city for charging the carriage which they propose to exhibit. The compressor, therefore, is not a large one, and no attempt at fine power economy has been made. In the design of the machine, however, although simplicity and lightness have been constantly aimed at, the compressing end of the machine is found to be extremely easy and economical in operation. The steam engine has a plain slide valve without cut-off, and with a common throttling governor. The piston rod is carried out through the back end of the steam cylinder and continuously connected through the entire compressing system. The four air compressing pistons are all single-acting rams, the diameters being 9½ inches, 4½ inches, 2¼ inches, and 1⅛ inches, respectively. The two larger pistons do their work on the stroke toward the crank, and the other two on the return stroke, the work being nearly equal for each, and the machine being balanced as nearly as possible. The first cylinder is that with the long feet bolted to the standards of the bed. The other cylinders are attached endwise to this, and outer supports are provided for steadying them. The base is a large water tank which serves as the intercooler between each stage of the compression. The large vertical air pipe carries the air from the first cylinder through a coil of copper pipe in the base and up to the farther end of the second cylinder. A smaller pipe from the other side of this cylinder leads the air down and through another copper coil, and then up. at the back end of the machine, to the third cylinder, the smallest pipe performing the same service between the third and the fourth cylinders. All of the air valves are poppet valves of forged steel and are instantly accessible. The packing for the various rams is also accessible from the outside, so that adjustments may be made without taking the machine apart. The normal speed of the machine is about 100 rotations per minute, and when compressing to 2,500 pounds, for which the machine is designed, the horse-power is about 35. This machine would seem to be well adapted to the purpose and the precise conditions for which it has been designed, and with the variety of experimenting with compressed air now going on it should be in demand. It could, of course, be used also for producing liquid air. It comes to us from the Pacific Coast, having been designed by Mr. E. A. Rix, of San Francisco, and built by the Rix Engineering Company, of which he is president.



A FOUR-STAGE HIGH-PRESSURE AIR COMPRESSOR.

A Balanced Valveless Gas or Gasoline Engine.

The engine shown in the accompanying sketch possesses some points of interest, especially in connection with automobile service, to which it is suggested that it is especially adapted. The balanced feature of the engine is comprised in the use of one long cylinder, which may be horizontal instead of vertical, as here shown, and in which work two pistons connected to opposite cranks on the shaft, so that the motions of the two pistons are always in opposite directions, and the movement of the one balances that of the other. This principle was employed in steam engines more than a score of years ago, or, perhaps, at a much earlier date. There are, however, other features in the present engine which give it, as a whole, considerable novelty. The engine is not only balanced, but "valveless."

Two vertical sectional views of the engine are given, one parallel with the shaft and one at right angles to it. In Fig. 1 the pistons are each at their extremes of travel outwardly, and in Fig. 2 they are at the extremes of their inward

travel. In the latter position the pistons are still at quite a distance from each other, and their opposite faces, with the enclosing cylindrical surface, form the explosion chamber of the engine, and the power of the engine is derived from the driving of the pistons apart by the increased pressure behind or between them, produced by the explosion. The pistons receive this impulse at each rotation of the shaft, or after each successive inward stroke of the pistons. There is an enclosed chamber *J* above the cylinder, and another chamber *K* below the cylinder, the latter chamber enclosing the crank shaft. These chambers *J* and *K* freely communicate with each other by means of the two passages in which the connecting rods to the upper piston play. These chambers are normally filled with the explosive mixture of gas and air, or gasoline vapor and air, ready for admission to the explosion chamber of the engine. A mixer *H* is provided for mixing the gas with its due proportion of air before entering these chambers.

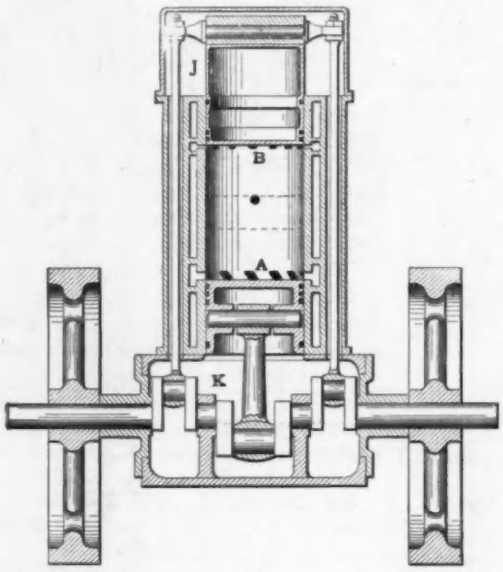


Fig. 1

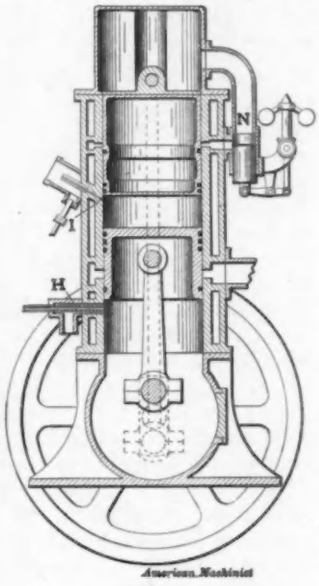


Fig. 2

A BALANCED GAS OR GASOLINE ENGINE.

The cycle of operations may be understood by reference first to Fig. 1. With the pistons in the position here shown the discharge ports *A* are uncovered and the products of combustion are being discharged through them. At the same time the admission ports *B* are also uncovered, and a new charge of the explosive mixture rushes in and fills the cylinder simultaneously with the escape of the used-up charge through the ports *A*. As the shaft continues to rotate the pistons approach each other, the cylinder ports are closed and the new charge of explosive mixture is compressed, and thereby heated, until when the pistons are nearly in the position of Fig. 2 the mixture is fired by the igniter *I*, and the explosion of the gases occurs to drive the pistons apart and impart their impelling force to the shaft during the next semi-rotation. When the pistons approach each other a partial vacuum is produced in chambers *J* and *K*, and in consequence of this vacuum a quantity of the explosive mixture rushes in through the mixer *K*. The passage by which the mixture enters is, of course, always covered by the piston except at this small portion of the stroke. The engine is governed by controlling at *N* the amount of the explosive mixture that is admitted to the cylinder. The cylinder is, of course, water jacketed, and provision is made for a proper circulation of the water. The engine was designed by Franz Burger Fort Wayne, Ind.

Electrically Driven Tools.

The machine-tool display at the recent electrical exhibition at Madison Square Garden was not very large, due mainly perhaps to the fact that there is such a lively demand for tools at present that few people feel like sparing them for exhibition purposes. They are now being mostly shipped to customers as soon as completed.

Two tools were shown, however, both having some new features and of special interest to electrical people. One of these was a 28-inch engine lathe, built by Dietz, Schumacher & Boye, and with a Bullock motor on the spindle in place of the usual cone pulley. On a sleeve fitting over the spindle is a spider, to which the motor armature is attached, and there are four poles built up of laminated plates. By means of the Bullock system there is a variable speed control which gives great range of speed without loss of torque, this lathe having, by a simple movement of the lever, speeds ranging from 60 to 250 revolutions per minute, arranged in eight progressive steps. These speeds are controlled by a crank handle placed on top of a vertical shaft at the right-hand end of the carriage apron, this shaft connecting by means of bevel gears with a splined shaft running along in front of the bed and below the carriage apron. The speed-shifting lever is thus in the most convenient position for the operator, and the speed is always under his absolute control without the necessity of his moving from his place.

There was shown also one of the new back-geared shapers made by the Cincinnati Shaper Company, which we illustrated in our issue of May 11, and which in this instance was driven by an attached motor and was shown in operation.

Letters from Practical Men

That Piston Once More.

Editor American Machinist:

In your issue of May 25 Mr. Willard has an article about the piston. He says the core boxes can be made in one hour. It would not take near the time to make the stop-off piece that I described that it would to make the core boxes, as anyone will admit, and the patternmaker who will make these core boxes in one hour is certainly doing his duty to his employer, and ought to be very much in demand. Ditto with the coremaker who will cut the rods, make, handle and blacken the twelve cores in 2¼ hours. If he had a good many to make this would be at the rate of 53 cores in 10 hours; a big day's work, and he would certainly be a "hustler." Then there is the expense of core sand wasted on twelve cores; not much of course, but it all counts.

Mr. Willard emphatically says the piston cannot be stopped-off in 2¼ hours, the time it took to make the cores. For the benefit of Mr. Willard I will say that I know a molder, "without an s," that will not take 2¼ hours to stop it off, but will (to use his own expression) "for love or money" do it in 45 minutes, "and do it as it should be done."

He also asks if I "consulted" a molder in regard to which he would rather do, stop it off or use the cores. When I have a job of this kind I do not "consult the molder" as to which he would rather do, but figure out which would be the cheapest way to do the job, taking into consideration the different departments it passes through, pattern shop, core room and foundry; and in this instance the plan of stopping-off is certainly the cheapest (as anyone ought to see), even if it did take the patternmaker only 1 hour, the coremaker 2¼ hours, and the molder and helper 1 hour.

If Mr. Willard will study the sketches of March 16 issue more carefully he will find that he is mistaken when he says that the segment cannot be drawn to the

center, for the sand is never rammed upon both sides of the ribs, so to pull the segment towards the center is the proper way, and if he prefers he can take one rib off after making the first ram, and let that end of the segment rest upon the filled-in sand, and the other rib against the 48-inch diameter until he reaches the last portion of the circle, when he takes off the other rib.

LOUIS BADEN.

The Discussion of Small Things.

Editor American Machinist:

I notice that Mr. Plaisted seems to suggest that the little discussion about the drawing of hexagon nuts, which occupied a column or so in three or four recent issues of the "American Machinist," was a somewhat unnecessary and unprofitable waste of valuable space. As I am perhaps somewhat responsible, as having started the affair, I may perhaps be permitted to add a few words at the end of it. As Mr. Plaisted had read only "a few of the numerous articles"—total number at that time five—he may not have read mine, which told of what I wanted to get at. Machine draftsmen have many hexagon nuts to draw, and they of course get into quick and handy ways of drawing them. I showed the best way that I knew, and I have now learned two or three better ways; so that if nobody else has got any good out of it, I have. The different ways of doing it that appeared showed that there is no established conventional way of drawing numerous small hexagon nuts, as a draftsman often has to do, although all the drawing books give a choice of styles for drawing screw threads and some other things less frequently drawn than hexagon nuts. Of course, I did not want a learned treatise on the preparation of a correct projection of the hexagon nut, as "M. E." favored us with. The shortest notes and the simplest diagrams that appeared were the ones that I was after.

MORRIS FULTON.

Diagram for Nuts.

Editor American Machinist:

Noticing Mr. Babbitt's diagram for the long and short diameters of hexagon nuts, I was struck at once with the convenience of the diagrams and the time they would save, if our friend had carried his idea a little further and added a third scale, giving the bolt diameters.

I send herewith a chart showing at a glance the size across the flat and across the corners of hexagon nuts for bolts from ½ to 4 inches in diameter.

Heretofore I have referred to the various hand books for the dimensions of nuts, etc. Now, thanks to Mr. Babbitt and the "American Machinist," I will keep a "nut diagram" within easy reach of my drawing board.

CHARLES EDWIN WARD.

Charleston, W. Va.

Making Surface Plates.

Editor American Machinist:

If the editor will permit telling day dreams I will tell one of mine that keeps returning every once in a while and sometimes oftener. Dreams are like religious arguments, it is hard to tell where to stop. But as this dream is about surface plates it is easy to tell where to stop, especially if you are the purchaser—you stop when you are broke.

I see no reason why surface plates should sell so high. There is no patent on them that I know of, and they are not controlled or cornered by any trust or syndicate, and it is an easy matter to imagine a plane surface. Now why not make them about as easy.

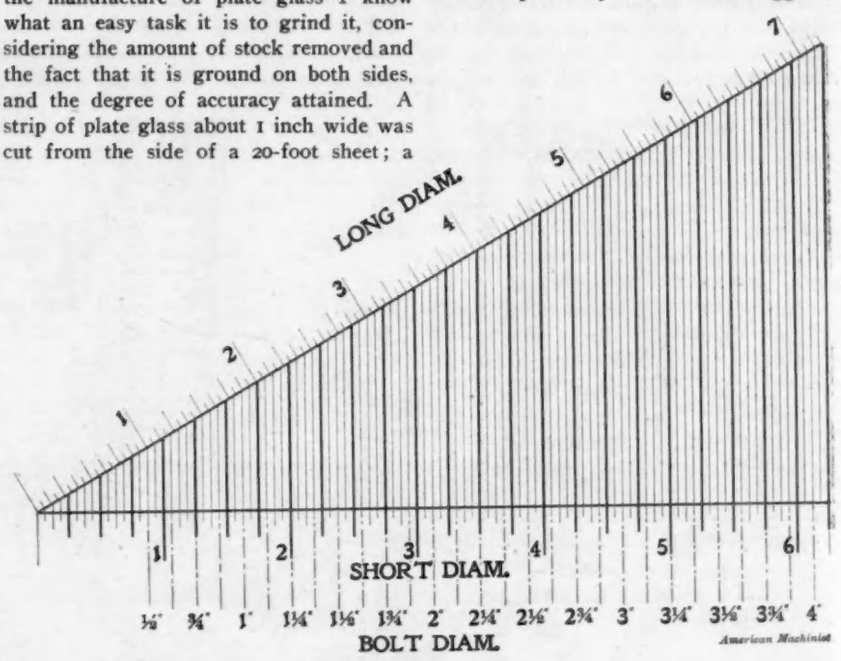
As I have had something to do with the manufacture of plate glass I know what an easy task it is to grind it, considering the amount of stock removed and the fact that it is ground on both sides, and the degree of accuracy attained. A strip of plate glass about 1 inch wide was cut from the side of a 20-foot sheet; a piece about 1 inch square was cut off of each end of this strip and one out of the middle; then these three squares were placed side by side, with a straight edge placed on top, and they were so near of a thickness that a piece of tissue paper placed on the middle square would leave the outer ones free; or if the tissue paper was put on one of the outside squares the middle one would be free. Consider that this plate was ground on both sides; hence the inaccuracy was less than half the thickness of tissue paper. Now cut a surface plate 12 or 18 inches square out of a surface like this, and I doubt very much if there are very many mechanics running around loose who could detect the error. Don't understand me to say that all plate glass is this accurate. Not by any means, for it sometimes varies considerably; but it is possible to attain such results with a good machine and a man that knows his business.

As to the price of surface plates, one 12 inches square costs, I think, about $10, and one 6 feet square would take an Illinois farm well stocked to make the first payment.

Suppose we were grinding surface plates on a plate glass grinding machine with a 30-foot table. A 30-foot table has about 700 square feet in it, and every square foot would represent a 12-inch surface plate at $10 per plate, or $7,000, and if they can be produced by this method the whole bunch can be surfaced in twenty-four hours, and by putting a few of the large ones in the center one could increase his income to any amount he was in need of. Won't someone with gigantic nerve try this and then tell us about it.

HUGH HILL.

[Although it may be possible to produce surface plates by the method suggested, we do not think that the fact that three pieces obtained in the manner described were found to be of the same thickness proved necessarily that the sheet of glass was ground to a perfectly plane surface. Segments of a sphere or of a cylinder of large diameter ground on both sides might easily stand the same test.—Ed.]



A DIAGRAM FOR NUTS.

Incomplete P. O. Addresses.

Editor American Machinist:

Apropos of the complaint of the Adams Company that only the name of a foreign town is given, without further address, I may say that when no country is given, it is assumed that none is necessary. For instance, London, Paris, Berlin, Wien (which we miscall Vienna), Leipzig and Dresden are well enough known to require no further particulars. What I complain of is for those who are not sure where a town is, to guess wrongly at it. Thus I get letters "Dresden, Austria," quite often, and "Vienna, Germany," is

sometimes put on boxes. There might be a dozen Viennas in Europe, but if just "Vienna" is given, the letter will get to Austria all right. A letter mailed in Dresden and addressed just "New York" will go to Manhattan Island all right enough. If you want to make a Chicago man mad, just put "Illinois" under the name of his town. He will say that that is "just New York jealousy."

Incidentally, I may suggest that for Americans to send freight to Dresden *via* Liverpool, shows that "the schoolmaster is abroad" in some towns.

Dresden. ROBERT GRIMSHAW.

Personal.

R. G. Schneble has left the position as superintendent of the drop forge department of the Columbus Bolt Works, and is now draftsman for the Hoover & Gamble Company, Miamisburg, Ohio.

Mr. Jerry Moffitt, until recently master mechanic of the Martin-Copeland Factory, at Providence, R. I., has entered the employ of the American Optical Company, Southbridge, Mass., in the machine department.

Our occasional contributor, Theodore H. Miller, who for some years has been in charge of the gage department of the Mergenthaler Linotype factory, Brooklyn, has resigned to become superintendent of the shops of the Elliott & Hatch Book Typewriter Company.

Mr. John A. F. Aspinall has been made general manager of the Lancashire & Yorkshire Railway, and Mr. H. A. Hoy, who has been in charge of work in the locomotive department at Horwich and who visited this country last summer, has been made chief mechanical engineer in Mr. Aspinall's place. The appointments date from July 1.

Obituary.

Just as we go to press we learn of the death of Mr. Charles A. Bauer, of Springfield, Ohio. Further particulars will be given later.

Richard Garstang, Jr., of St. Louis, died at Tucson, Arizona, May 14; twenty-nine years old. His father is proprietor of the Southern Boiler Works, of St. Louis, and young Garstang was his right-hand man.

Death of President Thomson.

The death of Frank Thomson, president of the Pennsylvania Railroad, which occurred on June 5, we cannot but consider as the untimely ending of a successful career. His record was at once honorable to himself and to the great institution with which he was life-long connected. He stepped from the schoolroom into the shops of the company, and he never had any other employer. He was fortunate in being from the first connected with an organization an essential feature of whose management was recognition and appreciation of efficient and faithful service. If his advancement was, as a whole, phenomenally rapid, it is to be remembered that it was constant, and he had no lost years of waiting for opportunities. These seem to have been always ready at hand as his abilities developed. The son of an ex-member of Congress and a man of influence, the position of the lad as he first entered the shops was not that of the ordinary wage-earning machine-shop apprentice. He was under instruction in the shops for three years, and during that time rapidly acquired technical knowledge. Then came the civil war, and at twenty years of age Thomson became the assistant of Colonel Scott in charge of military roads, superintending transportation and reconstruction as the exigencies of war demanded. He was relieved from military duty some time before the end of the war, and then became superintendent of the Eastern division of the Philadelphia & Erie Railroad, which position he held for nine years. In March, 1873, he was made superintendent of motive power of the Pennsylvania Railroad, the great shops at Altoona coming under his control. In July, 1874, he became general manager of the Pennsylvania lines east of Pittsburgh and Erie; in 1882 he became second vice-president, and in 1883 first vice-president. During the fourteen years of his vice-presidency he was in close touch with all the railway interests of the country. The presidency of the road came to him in the natural course of events upon the death of George B. Roberts, in 1897.

By a happy combination of natural force and ability, of opportunity and of practical appreciation, Mr. Thomson became an almost ideal all-round railroad man, and his success and progress seem to have been, from beginning, to end, without a set-back. Mr. Thomson, notwithstanding his busy life, became also an accomplished gentleman, appreciative of art and of all that wealth and culture find delight in. His health until recently had been excellent, and a career of high achievement ended with little warning.

To Make Liquid Air Wanted.

A representative of this paper had recently the pleasure of visiting the plant, just completed in this city, of the General Liquid Air & Refrigerating Company. This is a plant deliberately established for the purpose of manufacturing a want. If there has ever been anything produced which was not originated to satisfy "a long-felt want," it is liquid air. Children have not cried for it, and no one up to date has really known what to do with it in a practical and profitable way. Nevertheless, here is an installation established on a commercial and money-making basis for the production of liquid air, with confident assurance that it will make its own market.

This plant is for many reasons one of the most interesting things in a mechanical line in the world to-day. It is admirably complete and perfect in detail, and is such an installation as the intelligent engineer can inspect with pleasure and with complete satisfaction. The room in which the apparatus is contained is high, and lighted only, but very satisfactorily, from the roof. At the back of the apartment are two vertical boilers, and the steam goes from these to the two air compressors, which together comprise the four-stage compressor, which is the principal agent in the process employed. The first compressor (both being of the familiar Ingersoll-Sergeant straight-line construction) has a steam cylinder 16x18 inches, and the first two compressing pistons are upon a tail-rod carried back from the steam piston. The outer and larger air cylinder is connected to the liquefier by a piston inlet pipe; and, as a considerable vacuum is maintained in the liquefier, the air enters the first cylinder at a pressure several pounds below that of the atmosphere. The air which is not liquefied is re-compressed, and enough new air is continually admitted to make up for the liquefaction and for what leakage may occur. The air passes through a cooler and dryer before entering the first cylinder, and through an intercooler before entering the second cylinder, from which it is delivered at a pressure of about 60 pounds, gage. The air then passes another intercooler before crossing over to the other compressor. Although the two compressors are not connected, there is no difficulty in adjusting their relative speeds so that the proper share of the work will be apportioned to each. The steam cylinder of the second compressor is 22x24 inches, and the two compressing cylinders at this side are each single acting. The last cylinder is submerged in a water tank, which contains a coil of pipe for cooling the air between the third and fourth compressions. The air is finally delivered at a pressure of 1,000 pounds, or less than one-half what has been previously employed. Successful results have been obtained with compression to only 800 pounds. After leaving the last cylinder the air passes through an after-cooler and dryer before entering the liquefier. The liquefier embraces nothing new in principle, but much in detail, over the previous constructions of Linde and some other European experimenters, and several patents, issued and pending, of the inventors of the present apparatus, Messrs. Ostergren and Burger, are embodied in the construction. The actual, demonstrated success of the apparatus is the wonder of it. This plant is capable of producing liquid air at the rate of one gallon per minute, and at a power cost, as nearly as can be at present ascertained, of less than one-third of that accomplished by any previous experimenter.

The manufacture of liquid air by such

a complete series of apparatus as is here installed is unique in the business world. The compressors may be run continuously and the product may flow without ceasing, with absolutely no cost for material, and with no labor except that which is involved in keeping the engines going. A mechanical stoker seems to be the only thing lacking to make the installation perfect. The fuel cost of the present plant could be still reduced one-half by the employment of engines of a more economical type than the plain slide-valve, non-compound, non-condensing engines here installed, and which are as satisfactory as could be at present required. That we shall see the larger installation, with all the modern steam economies, the present proprietors have full confidence. As was said, this enterprise is undertaken with the belief that the market is sure to come. There are so many already suggested uses for liquid air, and some actual ones, that it can hardly fail to make its way, and perhaps with great rapidity, and nothing can more efficiently promote its extensive use than the cheapness of its productoin and the ease with which it may be procured by those who want it. We are not aware that any price has yet been made for the air, but this will, of course, soon be fixed. The present enterprise represents actual business conducted upon business principles, and there is no mystery or hocus-pocus about it, and no visionary or unwarranted statements are put forth concerning either the present or the future of it.

Technical Publications.

"Locomotive Data." This is a small morocco-covered book issued by the Baldwin Locomotive Works, of Philadelphia, and in which are given some of the leading data relating to locomotives, such as train resistances, curves, acceleration, hauling capacity, etc. There are also a number of useful diagrams, and altogether the book is an excellent one for a man who has to do with locomotives. We understand it is sent gratis on application to the Baldwin Locomotive Works, Philadelphia.

"A Primer of the Calculus." Second edition, revised and enlarged. By E. Sherman Gould. 122 4x6-inch pages, with 24 illustrations. Van Nostrand Science Series, No. 112. Price, 50c.

The first edition of this book was noticed in these columns at its appearance. The call for a second edition at so early a date indicates that the book has filled a want, and the author, besides some minor revisions, has supplied an additional chapter of illustrative examples. The book does not go beyond the elementary portions of the science, but it gives a good treatment of these portions, and especially points out the usefulness of this branch of mathematics.

"The Steam Engine Indicator and Its Appliances." By Wm. Houghtaling. 307 6x9-inch pages, with 157 illustrations. The American Industrial Publishing Company. Price $2.

The author of this book is obviously a man of experience who feels that he has something to say; but he is handicapped by a lack of information on fundamentals and by a lack of command of the English language. The things which he ought to know, but does not, he would, we presume, dismiss as "theory"; but there are things which one should understand or let alone when writing a book. Thus we are told "the foot-pound . . . represents the force necessary to lift 1 pound 1 foot high. . . . The horse-power of a steam engine is therefore denoted by the number of pounds it is capable of raising to a given hight in one minute." Following this is the correct method of finding the horse-power; but it is clear that the author has no clear idea of the difference between force and work. Again we read: "There is no absolute correct method of constructing the adiabatic curve, because it is almost impossible to ascertain the exact amount of heat that has been imparted to the steam during the stroke of the engine; therefore only an approximate curve can be drawn by and with the aid of a table of the properties of saturated steam." It is obvious from this, and from other portions of the same chapter, that the author does not know what the adiabatic curve is. He makes two errors in one sentence. In the first he confounds it with just what it is not—the curve due to the addition of heat to the steam during expansion—and in the second, with the saturation steam curve. These errors are not confined to subjects of this class, but are found in connection with every-day matters. For instance: "Valve lead is the amount of opening of the steam port (permitted by the valve) for the admission of steam to the cylinder *just before* the piston arrives at the extreme end of its stroke." In such important matters as the errors of various reducing gears no accurate information is given. We are merely told that a certain arrangement "will give fair results." Another, which is distinctly inferior to the first, is said to be "about equal" to it, and the best of all the simple lever motions is not shown at all. The English used is positively bad. We are not sticklers in this particular, knowing full well that perfect English is not to be looked for from technical writers of either high or low degree; but the use of words in this book is positively painful. The author writes conscientiously and with a serious purpose, and we are sorry to have to write as we have done regarding his book. It is not indeed to be condemned outright; but, for the reasons we have given, it is certainly not well adapted to supplant the books on the same subject which have preceded it.

The Bursting of an Old Fly Wheel.

In the paper on "Fly-Wheels," by Mr. John Fritz, printed in our issue of June 1, he describes an old way of making such wheels with cast-iron rims and hubs and wooden arms. A wheel of this type, 20 feet in diameter and weighing 20 tons, recently burst at Conshohocken, Pa., with destructive effect. The governor belt broke while the engineer was out of the engine room, and the engine ran away. One piece of the rim went straight through the end of the mill, struck a passenger car on the Reading Railway and cut it in two. The missile lodged in a brick house, completely wrecking the front and causing the first and second stories to fall in. An arm of the wheel struck a man on the head without killing him, otherwise no one was hurt.

Early Steam Engines in Breweries.

The use of steam power in breweries, there can be little doubt, says the "Country Brewers' Gazette," began in London, and for the excellent reason that there first the establishments became, in several cases, on too large a scale for hand or horse-power to suffice any longer. Towards the end of the last century several London breweries had become really large places, in fact they would be considered so still, compared to the great mass of breweries. The improvements in the steam engine, due mainly to James Watt, had rendered it fairly economical, and coal being cheap in London, owing to the facility of sea transit, it became commercially profitable about 120 years ago, to use steam instead of horse-power where brewing was constantly going on upon the large scale. The first brewer in London, and most likely in this country, to set up a steam engine was Mr. Goodwyne, a porter brewer of East Smithfield, near the Tower, in 1784. This machine was the first in London erected by Boulton & Watt, though it was made, of course, at their works at Soho, near Birmingham. Goodwyne's engine was employed for pumping and grinding, and turned out so superior to the horse-mills generally used, that the next year Mr. Whitbread put one up at his brewery in Chiswell street. It was used for grinding malt, which was effected in those days with mill-stones, like those, till lately, always employed in wind and other mills for grinding wheat. Four pairs of stones were run by it, on about one bushel (84 pounds) of coals per hour. Other London brewers quickly followed suit; the two Messrs. Calvert, for instance, had each one, so had Mr. Thrale, so well known as the friend of Dr. Johnson. These were all made at Soho, but set up and put to work by the elder Rennie, and were of 10 horse-power, with cylinders 2 feet diameter, 6 feet stroke, and running at 18

(*Continued on page* 53.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 28.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co., Meriden, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J.L.Lucas, Prov., R.I. Send for index sheet.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

The Waltham Machine Works, Waltham, Mass., make a specialty of accurate work. Correspondence in regard to small automatic machinery, punches and dies, etc., is solicited.

Factory to Let—Elizabethport, 150x50; all improvements; 60 windows; rail and water; gas, sewerage, etc.; 12 lots with factory; cheap. Apply to Capt. Coote, Elizabeth, N. J.

Wanted—One hand traveling crane, approximate length 48 feet over all, capacity 35,000 pounds. Address, with full particulars and price, Swift & Co., Union Stock Yards, Chicago.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

For Sale—A well-established machine business; good opportunity for a manufacturer to add a lucrative line or for parties contemplating engaging in business for themselves; will sell patterns and drawings and castings finished and unfinished; separate if desired. Address "Opportunity," care AMER. MACH.

For Sale—Two (2) Worthington pumps, dimensions 10x14x10 inches, normal capacity each pump 1,332 gallons, together with valves, fittings and 128 feet 14-inch pipe; pumps can be pushed to 2,000 gallons per minute each; less than three months in use; reason for selling, no further use for same. Address "Manufacturer," AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Chief engineer wants position; best of reference. Box 40, AMERICAN MACHINIST.

Erecting-department foreman desires position; engine shop preferred. Box 39, AMERICAN MACHINIST.

Position by young mechanical draftsman: 5 years' shop experience; references. Box 47, AMERICAN MACHINIST.

Man, 8 years' experience manufacturing and selling typewriters, wants position developing new machine. Box 45, AMER. MACH.

Position desired as master mechanic; take charge manufactory, or department large establishment. Box 46, AMER. MACHINIST.

Situation wanted as business manager of gasoline engine works; 6 years' experience in leading company. Box 44, AMER. MACHINIST.

Mechanical draftsman wants change; 7 years' experience on steam and gas engines, air compressors, etc.; gas engine or motor carriage preferred. Box 42, AMER. MACH.

Mechanics, experienced in constructing the new automatic casting machine and dies, wish to associate themselves with some manufactory or capitalist. Box 479, Hartford, Conn.

A toolmaker with several years' experience as foreman of toolroom and general repairs in large factory, desires to make a change; is good manager, as references will show. Address Box 48, AMERICAN MACHINIST.

Position as foreman or assistant superintendent of machine shop, by a young man of 30; strictly up to date in the best shop methods and a hustler; can design special tools and jigs for turning out high-class interchangeable work rapidly and accurately; understands piece-work system, and can handle men to the best advantage. Address Box 49, AMERICAN MACHINIST.

Help Wanted.

Wanted—First-class mechanical draftsman. Enquire 115 Plymouth st., Jersey City, N. J.

Wanted—First-class green sand machinery molders; steady work to right men. Naylor Bros., Peekskill, N. Y.

Wanted—Mechanical draftsman on pumps; state experience, salary, age and give references. Box 35, AMERICAN MACHINIST.

Wanted—Eight first-class machinists on light experimental work. Call on or address at once Marvin & Casler, Canastota, N. Y.

Wanted—Draftsman familiar with large vertical engine design. Address, stating references and salary, P. O. Box 452, Pittsburgh, Pa.

Several first-class tool makers wanted on light interchangeable work; state age, experience and wages expected. Box 28, AMERICAN MACHINIST.

Wanted—First-class machinists for floor and vise work; best class heavy machine work; good wages; steady employment. Morgan Engineering Co., Alliance, Ohio.

Wanted—Two good machinists, two molders and one more pattern maker can find steady employment and good wages by applying or addressing, stating age, experience, to Kenney & Co., Scottdale, Pa.

Wanted—A tool maker used to light, fine work; steady job and good wages to satisfactory man; must be of correct habits and well recommended. Fulton Foundry & Machine Works, 21 Furman st., Brooklyn, N. Y.

Superintendent wanted, to take charge of gun factory employing 40 men, in a New England village; must be familiar with gun-making in its details; state age, experience and wages. Address Box 41, AMER. MACH.

Wanted at Once—12 first-class tool makers with 5 to 10 years' experience on fine tools; only A1 men need apply; steady work and good wages. Address Employment Bureau, National Cash Register Co., Dayton, Ohio.

Wanted—Pattern makers and machinists on high-grade compound steam-engine work; applicants will please give full particulars, such as age, salary, experience, last or present place employed. Address Box 31, AMERICAN MACHINIST.

Wanted—By well-known company, manufacturing generators and motors, a foreman for the machine shop; one who has had experience in similar work preferred; state experience and salary expected. Address Box 37, AMERICAN MACHINIST.

Wanted—Foreman, by an old, reliable firm in the steam fittings and brass goods line in the center of Germany, for brass foundry employing about 70 men; knowledge of German language required; state experience, age and wages expected. Box 335, AMER. MACHINIST.

Wanted—To go to south Florida, a good, all-round machinist; one that can tackle anything appertaining to a locomotive, stationary engine, boiler or pump; to a good man of steady habits this is a rare opportunity. Address John B. Barrody, Gen. Supt., Hull, Fla.

Wanted—Swedish tool maker who has been working on bicycle tools, dies and fixtures, and who is accustomed to handling men, for a bicycle shop in Stockholm, Sweden, as foreman and assistant superintendent; state salary, experience and give reference. Box 43, AMERICAN MACHINIST.

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actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 150 gals. per day. Used in 23 countries. Testimonials from the leading firms in every field of industry.

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(*Continued from page 52.*)

strokes per minute. They were of the beam type and single action, i. e., the steam was admitted during part of one stroke only, the condensation of the steam and the action of a heavy connecting-rod and fly-wheel effecting the return stroke of the piston. Boilers of nearly the same shape as a domed copper were employed, working, of course, at an extremely low pressure. In a few years' time the engine at Whitbread's was altered to double-action, i. e., the steam was admitted at either end of the cylinder, alternately, to drive the piston up and down. More steam would be wanted, of course, but the power of the machine would be at least doubled. The other early engines of this kind were similarly altered sooner or later, and the original "haystack" boilers replaced by long flat-ended ones, concave underneath, and somewhat resembling a wagon with its tilt or covering. Both these forms were without any internal flues, simply standing over the fire like brewing coppers, and could be warranted not to raise steam with dangerous rapidity. Not a high degree of expansion was employed, of course, the steam pressure being but little above that of the atmosphere to commence with, but a considerable economy of steam was effected. The fly-wheel was made large and heavy, its stored-up momentum being absolutely necessary for regulating any engine running with such a slow stroke. Messrs. Whitbread's engine worked for fully a century, or in fact until about 1887.

Some of the London distillers were also very early in the field as users of steam power in preparing grist, etc., and it was not long before engines became recognized as necessary in plants beyond a certain size. As a rule, in the small towns and country places, however, steam made its way but slowly in breweries in days when railways had not brought coal to every man's door. The cost of fuel for boiling water and worts was sufficiently heavy, while horse-power was available at a moment's notice. Large horizontal wheels of wood, fixed sufficiently high above the ground for a horse to stand beneath and be harnessed between two projections, were used for transmitting power to the machinery, the horse going round and round in a circular path. In breweries of medium size these wheels were usually of from 16 to 22 feet in diameter, and one, or at most two, horses were sufficient for the duty, but in the large London breweries wheels of greater size with more horses were necessary. At first the newly-erected steam engines were used to drive the large horse-wheel so that if the engine or boiler failed from any cause, the horses could be put in again temporarily. The writer saw a small brewery worked in this fashion only five or six years ago, although the use of horses would not, perhaps,

have been resorted to in case of a break-down. From the custom of using horses in this manner, the London brewers, when applying to Boulton and Watt for steam engines to replace them, always stated the number of animals employed at the work in question. Hence the engine had to be of so many "horse-power."

Mr. L. E. Bennett is at present in the city transacting business in connection with the newly organized American Trading Company, of Bangkok, Siam. This company has been organized under the direct encouragement of the Siamese Government in order to bring American manufacturers into competition with English and German houses who have been for some time established in that country, and it is the intention of the new company to find a market for such products of Siam as can advantageously be sold here, and at the same time to represent American manufacturers in the disposal of American goods in Siam.

The first patents relating to liquified air, which we have noticed are dated May 30, one being for a liquid air conveying conduit and one for a liquid air container for refrigerating purposes, both to a resident of Bay City, Mich.

Three of the largest shops of the Armstrong-Whitworth Ordnance Works, Newcastle-upon-Tyne, England, were destroyed by fire on the 11th instant, entailing a loss of about $1,000,000.

Manufacturers.

J. W. Smith will build a sawmill near Bolen, Fla.

The Little Daisy Roller Mills, of Faribault, Minn., will be considerably enlarged.

The plant of the Roach shipyard at Chester, Pa., is to be considerably enlarged.

J. H. Sternbergh & Son, Reading, Pa., will shortly build an addition to their rolling mill.

The Empire Manufacturing Company, of Lockport, N. Y., is contemplating the erection of a new building.

Mr. Geo. F. Lasher, Philadelphia, Pa., is about to have erected for him an eight-story factory building, 60x100 feet.

The Webb Chemical Company, Richmond, Va., is talking of building near the Cedar Works. It has recently purchased a site.

The Saco Pettee Machine Company, Newton Upper Falls, Mass., will erect a new building, 310x60 feet adjoining the works.

The Thorndike Cotton Mills, West Warren, Mass., are increasing the capacity of No. 1 mill by the addition of a room 300x14 feet.

A new electric power plant is to be installed at the Brooklyn Navy Yard for the use of the steam engineering bureau. It will cost about $100,000.

The American Steel & Wire Company, Pittsburgh, Pa., will enlarge the Edith furnace plant. A new stock is to be added at a cost of about $85,000.

The Barcalo & Ball Manufacturing Company, of Buffalo, N. Y., contemplates the erection of a new factory, two stories high, and to cost about $12,000.

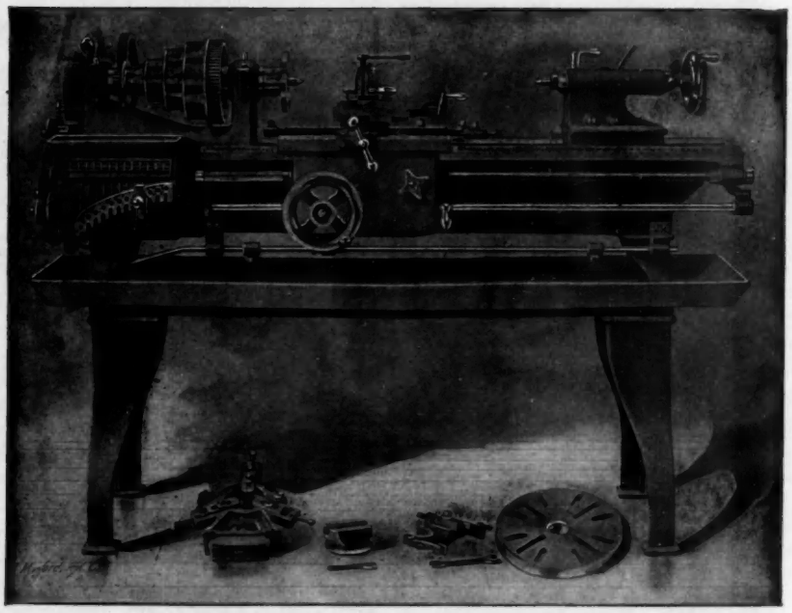
(*Continued on page* 55.)

The Hendey Machine Co.

TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 468,183, 470,591, 519,294, 549,006 and 557,031, granted to P. & W. Schellenbach, W. P. Norton, and W. L. Schellenbach, for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

The Hendey Machine Co.,

TORRINGTON, CONN.

UNITED STATES AGENTS:

Hill, Clarke & Co., Boston. Manning, Maxwell & Moore and The Garvin Machine Co., New York. J. W. Cregar, Philadelphia. U. Baird Machinery Co., Pittsburgh. The E. A. Kinsey Co., Cincinnati. Manning, Maxwell & Moore, Chicago. Pacific Tool & Supply Co., San Francisco.

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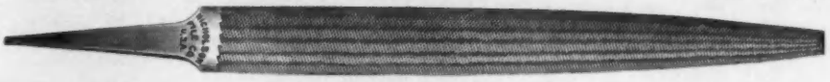

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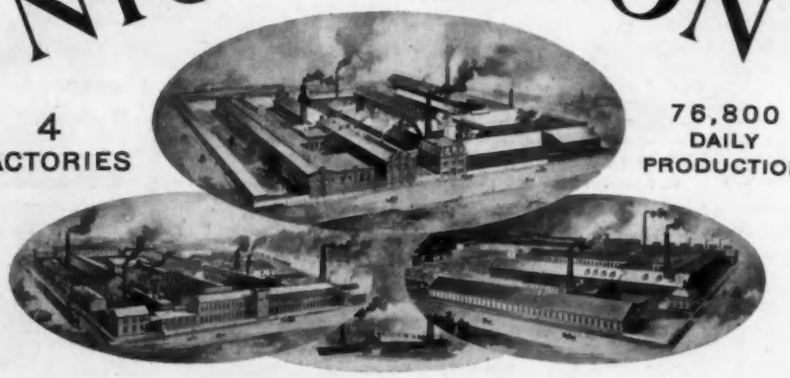

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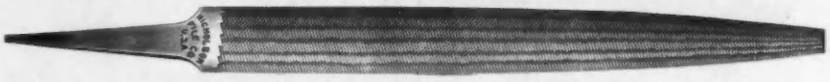

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GERMANY: Largest Dealers in each city.
AUSTRIA: J. G. Petzolt & Co., Vienna.
HUNGARY: Wohanka & Co., Budapest.
ITALY, SWITZERLAND, SPAIN, Etc., Etc.

(*Continued from page 54.*)

The stockholders of the Textile Manufacturing Company, Springfield, Mass., have voted to erect a three story and basement factory building, 40 by 200 feet.

The Daniel Manufacturing Company, of Raleigh, N. C., contemplates the erection of a new cotton mill. D. E. Rhyne, Edgar Lone and A. M. Price are the stockholders.

Architects D. K. Boyd and F. H. Lewis are making plans for a plant to be built for the William Krause & Sons' Concrete Company, of Philadelphia, Pa., at Martin's Creek, Pa.

Mr. F. M. Rakestraw, of the Be Vilbiss Computing Scale Company, recently took out a permit for the erection of a two-story brick factory on Albion street, Auburndale, Ohio.

Mr. T. W. Pratt has opened negotiations with the owners of the National Manufacturing Company's plant at Huntsville, Ala., with a view to doubling the plant, adding modern machinery.

The Syracuse (N. Y.) Tube Company contemplates the making of improvements and enlargements which will increase the capacity of the plant fully 50 per cent. and give employment to about 100 additional workmen.

William Steele & Son, 506 Walnut street, Philadelphia, Pa., are taking bids on a factory building to be erected for A. Berg & Co. from plans completed recently by Architect J. M. Cameron. The building will be three stories and basement.

John Woodward & Co. will commence work at once on the extension of their building on Broadway, Council Bluffs, Ia. The improvements and additional machinery which the company proposes to install will necessitate an outlay of about $30,000.

The North Star Oats Mills, at Cedar Rapids, Ia., are to be enlarged at once. An additional plant, at a cost of $25,000, is to be erected. This will give the entire plant a capacity of 600 barrels per day, and will give employment to 400 additional hands.

The brick addition to the plant of Williams Brothers & Charbonneau, at the corner of Grand River and Kirby avenues, Detroit, Mich., is nearing completion. The E. G. Dailey Preserving Company is also about to build an addition to its plant at the corner of Kirby and Wabash avenues.

H. B. Mutch and S. K. Paige, of Boston, are in Cumberland and Pictou counties, Nova Scotia, looking for a site for proposed iron smelting works. H. M. Whitney's works are to be in Cape Breton, and the Nova Scotia company will also erect mills there in addition to their works in Ferrona.

The plant of Stanley G. Flagg & Co., at Stowe, Pa., will be enlarged. The contract for this has been awarded to Contractor L. H. Focht, of Reading, Pa., and he will begin operations on its erection at once. The building will be of brick, two stories high, and will be used as a machine shop and tapping room.

The Wheeler & Wilson Manufacturing Company, Bridgeport, Conn., is making extensive improvements on its plant, and has placed the contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for a new foundry building, and also for a one-story building covering a portion of their present yard.

The International Car Wheel Company was incorporated at Trenton, N. J., recently. The incorporators are P. H. Griffin, T. Guilford Smith, Buffalo, N. Y.; Edgar McDougall, T. J. Drummond, Montreal, Can.; Albert D. Besson, Boston, Mass.; H. L. Saterlee, New York; Howard K. Wood, Jersey City, N. J.; J. Fred Pierson, Ramapo, N. Y.

Articles of incorporation of the Omaha (Neb.) Mechanical Boiler Cleaner Company have been filed with the county clerk. The

capital stock of the company is $100,000. The company's headquarters will be in "The Bee" Building, Omaha, Neb. It expects soon to erect a factory which will furnish employment to a large number of mechanics.

The Amazon Knitting Company, Muskegon, Mich., will at once enlarge its factory by erecting an addition to its main building, 60 by 161 feet and five stories high. A new brick warehouse, 58 by 118 feet, and an addition to the boilerhouse, 36 by 28 feet, will also be erected. These additions will increase by one-third the manufacturing capacity of the industry.

Messrs. Gerhard Heintzman & Co., piano manufacturers, of Toronto, Ont., have found it necessary to enlarge their factory. They are now building an extension in the rear of their factory on Sherbourne street, the estimated cost of which is $20,000. It will be a five-story brick structure, with dimensions of 80x160 feet. It will be furnished with the most modern appliances in the way of machinery, boilers, etc. It is expected that the new building will be completed by September 1.

At a meeting of the directors and stockholders of the Delaware Iron Company in Wilmington recently, it was decided to sell the big plant on the Delaware river front at New Castle to the National Tube Company, the new iron-pipe trust, which was recently incorporated under the laws of New Jersey; capital stock, $80,000,000. It was announced that the purchasers, the National Tube Company, will enlarge the mills and equip them with the latest and most improved machinery. The works at present are in full running order, and about 500 men are given employment.

New Catalogs.

The Goldie & McCulloch Company, Limited, Galt, Ont., has issued a small booklet in which is illustrated and described the "Model" gas and gasoline engine. Various parts of these engines are minutely described. They are built in sizes ranging from 2 to 25 horse-power. The catalog is 3½x6½ inches.

We have received from Sawyer Tool Company, Fitchburg, Mass., Catalog "C" of rules, center gages, screw pitch gages, calipers, surface gages and numerous other tools used by machinists. The catalog contains a number of tables of decimal equivalents, weights of steel and brass plates and several others. The catalog contains 64 4x5¾-inch pages.

J. Sagar & Co., Halifax, England, send us catalog of wood-working and sawmill machinery. Mortising, band-sawing, planing and molding machines are illustrated and described. The catalog contains a number of views of various departments of the plant. A number of notes which should interest machinery users are contained in the catalog, which is 6x9¾ inches.

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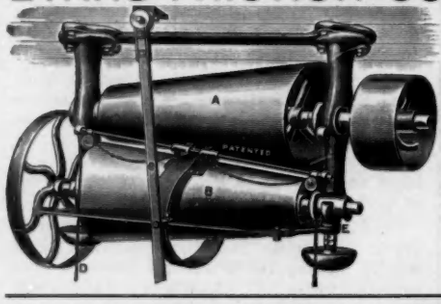

The following is a partial list of Manufacturers who have Evans Friction Cone Pulleys in operation:

National Biscuit Co., Richmond, Ind.,	150 Sets, 6 H. P.
John & James Dobson, Philadelphia, Pa.	34 Sets, 2 H. P.
Samuel Cupples Co., St. Louis,	25 Sets, 3 H. P.
Atlas Cement Co., 143 Liberty St., New York,	8 Sets, 20 H. P.
Washburn & Moen, Worcester,	A large number, all sizes.
Nonotuck Mills, Holyoke, Mass.,	16 Sets, 6 H. P.
Stinson Brothers, Carpet Mfgrs., Philadelphia,	40 Sets, 2 H. P.
Massasoit Paper Company, Holyoke, Mass.,	2 Sets, 40 H. P.
F. W. Bird, East Walpole, Mass.,	2 Sets, 40 H. P.
Arnold Print Works, North Adams, Mass.,	10 Sets, 6 H. P.
Merrimack Mills, Lowell, Mass.,	18 Sets, 10 H. P.
Dennison Mfg. Co., Mass.,	Large number.

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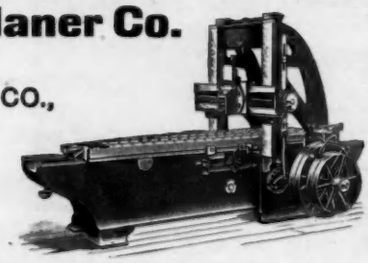

U. Baird Machinery Co., 125 Water St., Pittsburgh, Pa.
Robinson & Cary Co., St. Paul, Minn.
W. R. Colcord Mchy Co., 502 North 2d St., St. Louis, Mo.
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